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THE LOWER EOCENE KNIGHT FORMATION OF WESTERN WYOMING AND ITS MAMMALIAN FAUNAS

(WITH 11 PLATES)

BY

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CONTENTS

ILLUSTRATIONS

Plates

(All plates following p. 82.)

Figures

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INTRODUCTION

The variegated beds of the Wasatch group in southwestern Wyoming have been of much interest to both geologists and paleontologists since their description by Hayden in 1869. To vertebrate paleontologists significance lies largely in their having yielded the first known lower Eocene mammals from North America. Unfortunately, however, the term "Wasatch" was too broadly defined for precise geologic usage and included strata of more than one geologic age. In consequence of this, Veatch in 1907 redefined the term as a group and divided it in ascending order into the Almy, Fowkes, and Knight formations. The last-named formation, including the fossiliferous lower Eocene horizons, is the primary concern of this report.

Investigation by the Smithsonian Institution of the mammalian faunas of the Knight formation was largely an outgrowth of the discovery by U. S. Geological Survey parties of Paleocene vertebrate remains in underlying Almy deposits (Gazin, 1942). Collections by J. B. Reeside, Jr., W. W. Rubey, and B. N. Moore in 1936 and by Rubey and John Rogers in 1939 led us in 1941 to a careful examination of the Almy beds as exposed on La Barge Creek in Lincoln County, Wyo., and to a somewhat desultory search of the nearby Knight exposures along Green River in Sublette County. Examination of the two sets of beds was renewed in 1948, and an intensive search of the Knight exposures was made along the east side of Green River from the vicinity of the "Three Bridges" southeast of Big Piney to 10 or 11 miles south on Fogarty Draw. In 1949 search was extended to both sides of the Green River, on the west side as far south as La Barge, and to about 12 miles north of Big Piney. In 1951 re-examination was made of all the more profitable localities and investigation was carried upward into the New Fork member, a tongue of Wasatchian strata interfingering with the lowermost Green River beds in the same area.

Collections made from the upper Green River basin, together with materials from the Knight beds in the vicinity of Fossil and those of the earlier collections from the Knight on Bear River, result in our now recognizing at least four horizons for fossil mammals in pre-Bridgerian Tertiary of southwestern Wyoming. These include the Clarkforkian Paleocene stage represented by mammalian remains from the Almy on La Barge Creek, equivalent to part of the original Wasatch; a Lysite or about middle-Wasatchian stage represented by collections from the type locality for the Knight, and probably the Knight at Fossil; and apparently two horizons of general Lost Cabin equivalence supported by the collections from the upper Knight beds and New Fork beds along the Green River in Sublette County. The lower Wasatchian or Gray Bull has not been certainly recognized, except in the adjacent Hoback basin (see Dorr, 1952).

ACKNOWLEDGMENTS

In addition to the above-named members of the U. S. Geological Survey, I wish to acknowledge helpful information given me by Dr. G. E. Lewis, who made a small collection from Knight beds near the Green River in 1947 while working with Dr. Rubey on the Big Piney Quadrangle. George Shea, of Billings, Mont., very graciously aided in locating for me materials which he and G. E. Lewis observed in 1947. Acknowledgment is also made of the courtesies extended in connection with my work in 1951 by the geologists of the General Petroleum Co., the Mountain Fuel and Supply Co., and the Shell Oil Co. doing exploratory work in the same area. My field assistants in 1941 included G. F. Sternberg and F. L. Pearce. In 1948 I was aided by my wife, Elisabeth, and son, Chester Gazin; both accompanied F. L. Pearce and myself in 1949.

In the faunal study I am indebted to Dr. Glenn L. Jepsen for permitting me to examine and describe Knight materials in the Princeton University collections and make comparisons with type and other specimens there. Drs. G. G. Simpson, E. H. Colbert, and Bobb Schaeffer extended to me facilities of the American Museum of Natural History and permitted me to study Knight materials from the type locality and various type specimens of lower Eocene mammals in the American Museum collections.

The drawings depicting new forms in figures 2-6 were prepared by William D. Crockett. The photographs of specimens in plates 1, 2 (fig. 1), 5-8, 10, and 11 were made through the kindness of Dr. G. Arthur Cooper. Photographs in text figure 1, plate 2 (figs. 2-5), and plates 3, 4, and 9 were made by the photographic laboratory of the U. S. National Museum.

HISTORY OF INVESTIGATION

Special historic interest, as has been noted, is involved in consideration of the Knight formation and its faunas. Fossil mammalian remains from exposures of this formation along Bear River, near Evanston, Wyo., are apparently the first to be described from the lower Eocene of North America. From here Hayden, or Cleburne according to Marsh (1893, p. 321), in 1871 secured the remains that Cope (1872a) described as *"Bathmodon" radians* and *"Bathmodon" semicinctus,* and part of the material later described as *"Bathmodon" latipes.* In 1872 Cope, assisted by Garman, and while working for the Hayden Survey, collected the type of *Hyracotherium vasacciense* as well as materials that became the types of various turtles (1872b). It is of interest that in 1872 Cope's travels took him to the mouth of La Barge Creek in the general area of upper Knight beds that produced the materials forming the basis of this investigation. It is unlikely, however, that he made any collection there. The same year he obtained from the vicinity of Black Buttes, east of the Rock Springs uplift, teeth from two badly decomposed *Coryphodon* skulls that he named (1873b) *"Metalophodon" armatus.* Apparently again in 1873 Cope went over the exposures along Bear River, southeast of Evanston, and collected the type materials of *Hyracotherium index* and *Phenacodus primaevus* (1873a), and additional material of *Coryphodon radians* and *Coryphodon latipes.*

Cope's investigation in the Knight ended with his transfer of interest to the lower Eocene of New Mexico and our next record of activity in these beds is Marsh's description of *Coryphodon hamatus* in 1877. This was collected in about 1874, from exposures on Bear River, about "35 miles west of Bridger," by R. Veltman of Evanston, Wyo., formerly a storekeeper at Fort Bridger. Veltman first wrote[1] Marsh about having discovered large bones on Bear River in June of 1871. Marsh apparently did not follow up this information until Veltman wrote again in November of 1874, at which time he reported

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[1] Information kindly furnished me by Dr. J. T. Gregory from the file of Marsh's correspondence.

finding a skull and other bones of a very large animal, offering them for sale. These were evidently of the *Coryphodon hamatus* skeleton that Marsh eventually obtained. About the middle of the same decade Marsh acquired material of *Hyracotherium,* from the vicinity of Black Buttes, that in 1876 he named *Eohippus pernix.* William Cleburne, of the Union Pacific Railroad, in 1875 collected the skull and jaws that Thorpe (1934) described as *Meniscotherium robustum.* The latter was found in a cut on the old grade of the railroad about 2 miles west of Aspen (old location).

I have no further information on early paleontological exploration in these beds until 1906, when Granger and Miller collected about a dozen specimens of small mammals approximately 200 feet up on the bluffs of Bear River south of Knight station and in the vicinity of the railroad bridge. These are specifically mentioned by Granger in 1914 (p. 203) and regarded as Lysite in age.

More recent active interest in the Knight was recorded by Bonillas when, in 1936, with his description of the dentition of *Lambdotherium* from deposits near La Barge, Wyo., he mentioned the field exploration of the California Institute of Technology in these beds and cited briefly the fauna obtained. Their collecting was done largely in the vicinity of La Barge and included search on both sides of the Green River. Field work by parties from Princeton University in the Knight formation resulted in the discovery in 1939 and 1940 of fragmentary mammalian remains in Knight beds 40 to 100 feet below Green River strata about 3 miles northwest of Fossil, Wyo. Also, a jaw of *Ambloctonus* as well as an isolated tooth of *Oxyaena* were found by them southeast of La Barge in 1941. These, together with the above-noted finds of the U. S. Geological Survey and the more extensive exploration and collecting by the Smithsonian Institution, complete the history of paleontological work in the Knight of the Fossil and upper Green River basins, as far as it is known to me.

OCCURRENCE AND PRESERVATION OF MATERIAL

For practical purposes the Knight collections may be regarded as coming from three general localities or areas of exposure in the westernmost part of the State: one in the northwestern part of the upper Green River or Bridger basin and two in the adjacent, small but elongate structural basin to the west which includes the type section. In addition to these are a few isolated occurrences either at remote localities tentatively regarded as Knight or in exposures separated from the general localities by significant faulting.

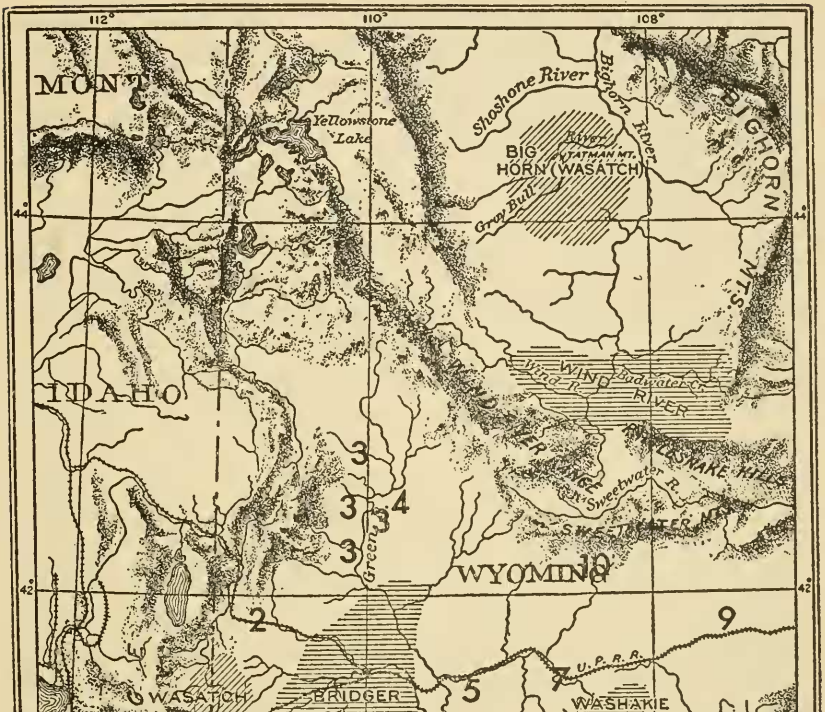

FIG. 1.—Map of southwestern Wyoming and portions of adjacent States showing Eocene sedimentary basins, with fossil localities in Knight formation numbered as follows: 1, Knight station, type Knight; 2, Fossil; 3, La Barge–Big Piney; 4, New Fork; 5, Rock Springs; 6, Vermilion Creek; 7, Black Buttes; 8, Dad-Baggs; 9, Great Divide basin; 10, Red Desert. Map reproduced from Osborn, U. S. Geol. Surv. Monogr. 55, figs. 9, 49, 1929.

Historically, the more important of the localities would be the exposures along Bear River, in general between Evanston and Knight station. Granger's collection came mostly from the bluffs south of Knight station, and the only detailed statement made by Cope (1872b, p. 473) regarding his collection refers to "upper red and white strata on the bluffs eleven miles S. E. of Evanston, or near the bend of Bear River." Except for the *Coryphodon hamatus* skeleton collected for Marsh, the materials so far recovered from this area have been very fragmentary. Those collected by Granger and Miller occurred in a yellowish or buff sandstone, somewhat conglomeratic, hence conditions of deposition were not the most favorable for preservation of the smaller mammals. The bone portion of the jaws of the smaller mammals is very poorly preserved and only the teeth are in reasonably good condition.

The exposures near Fossil, Wyo., from which Princeton obtained a collection, are about 45 miles due north of Knight station but in the same basin of deposition. The Princeton collection was made in variegated beds from 40 to 100 feet beneath the Green River formation about 3 miles north of Fossil. However, a jaw of *Phenacodus* was obtained by Dr. Dunkle for the Smithsonian Institution in gray exposures beneath the red beds just 3 miles to the east of Fossil. The materials from near Fossil are also fragmentary but the bone has more the appearance of that which occurs in the vicinity of La Barge and Big Piney.

The most prolific collecting ground in beds considered to be a part of the Knight formation are to be found in the vicinity of the Green River in Sublette County—from La Barge, approximately 40 miles northeast of Fossil, to a point about 12 miles north of Big Piney, Wyo. Fossil materials of this area are found in many places on both sides of the Green River; however, certain small patches or coves of exposures have proven much more productive than others. Materials here were encountered at various levels from as near as about 40 feet below Green River strata, to possibly 100 feet lower. A collection was also obtained from the New Fork tongue of Wasatchian beds in the lower part of the Green River section along Alkali Creek and New Fork, tributaries of the Green River to the east and southeast of Big Piney.

The Smithsonian collections, which are almost exclusively from the La Barge–Big Piney area, number a little under 600 and include materials in various states of preservation and completeness. Excellent skulls were found of some forms, showing varying amounts of distortion, but less in general than exhibited by materials from lower Eocene deposits in the Big Horn, Wind River, and San Juan basins. Not all specimens are free of an iron-oxide coating, but the prevalence of this condition is far less than in the Big Horn basin Willwood materials. No one horizon or lithology can be regarded as exclusively fossiliferous, except locally and for short distances, although certain dark reddish to purplish zones to the east of the Green River have been relatively productive, and a soft blue-gray shale at certain places on the west side between La Barge and Big Piney. A rather profitable concentration of materials was encountered about 12 miles north of Big Piney in reddish-buff layers and gray sandy shale.

Isolated occurrences include the Aspen locality for the type of *Meniscotherium robustum* (in the Green River basin of deposition and hence not to be confused with the type Knight), and the occurrence of *Coryphodon* and *Hyracotherium* near the upper reaches of Dry Piney Creek, referred to in 1942. In the eastern part of the Bridger basin, around the Rock Springs uplift, isolated occurrences presumably in the same formation include a *Meniscotherium robustum* skull collected by Roland W. Brown just southwest of Rock Springs; a small collection of fragmentary remains that I made from near the southern extremity of the uplift on a tributary of Vermilion Creek; and the Black Buttes occurrence to the east of the uplift. Still more remote, but nevertheless in the same depositional basin, may be mentioned the occurrences on the eastern margin of the Washakie basin beneath the Tipton tongue of Green River between Dad and Baggs, referred to in Wood el al. (1941, p. 18), and from northeast of Creston made by a U. S. Geological Survey party in 1907.

THE KNIGHT FAUNAS

The following tabulation pertains to the principal occurrences of fossil mammals in the Knight formation as it is exposed in the upper Green River basin (the La Barge and New Fork faunas) and in the adjacent small structural basin west of the Oyster Ridge which includes the type Knight and the occurrence at Fossil, Wyo. The figures used refer to the number of specimens encountered, giving an indication of extent of materials upon which identifications are based, and a suggestion of the relative abundance of various forms in the faunas.

	Knight station	*Fossil*	*La Barge-Big Piney*	*New Fork*
MARSUPIALIA:				
Peratherium edwardi, new species			2	
Peratherium chesteri, new species			1	
INSECTIVORA:				
Diacodon pineyensis, new species			3	
Diacodon, cf. *alticuspis* Cope		1		
Cynodontomys knightensis, new species			13	
Cynodontomys, species	1			
TILLODONTIA:				
Esthonyx, cf. *acutidens* Cope			3	
Esthonyx, species	1			1
PRIMATES:				
Pelycodus? species	1			
Notharctus limosus, new species			24	
Notharctus venticolus Osborn			6	
Absarokius noctivagus Matthew			3	
Paratetonius? sublettensis, new species			1	
TAENIODONTA:				
undetermined stylinodont			4	
EDENTATA:				
Pentapassalus pearcei, new genus and species			2	
RODENTIA:				
Paramys, cf. *buccatus** (Cope)	1		2	
Paramys, cf. *copei** Loomis			8	
Sciuravus, possibly *S. depressus* Loomis			1	
Tillomys senior, new species			1	
CARNIVORA:				
Thryptacodon, near *T. antiquus* Matthew			2	
Pachyaena? species				2
Oxyaena, species			1	
Ambloctonus, cf. *major* Denison			1	1
Prolimnocyon elisabethae, new species			3	
Sinopa vulpecula Matthew			5	
Sinopa, cf. *strenua* (Cope)			1	
Didymictis altidens Cope	?		14	
Viverravus lutosus, new species			8	
Uintacyon asodes, new species			1	
Miacis, cf. *latidens* Matthew			3	
Vulpavus asius, new species			6	
CONDYLARTHRA:				
Hyopsodus wortmani Osborn			29	1
Hyopsodus mentalis (Cope)			76	
Hyopsodus browni Loomis	4			
Phenacodus primaevus Cope	1	1 **		
Meniscotherium robustum Thorpe			93	
Meniscotherium, cf. *chamense* Cope				3

* *Paramys,* cf. *buccatus* in Knight is *Paramys excavatus* Loomis; and *Paramys,* cf. *copei* Loomis includes *P. copei, P. major,* and a new species, as determined by A. E. Wood.

** Recorded from a horizon stratigraphically lower than other forms cited in this fauna.

	Knight station	*Fossil*	*La Barge-Big Piney*	*New Fork*
PANTODONTA:				
Coryphodon radians (Cope)	X †		cf. 15	
Coryphodon semicinctus (Cope)	1			
Coryphodon latipes (Cope)	1			
Coryphodon hamatus Marsh	1			
Coryphodon, species		1		
DINOCERATA:				
Cf. *Bathyopsis fissidens* Cope				2
PERISSODACTYLA:				
Hyracotherium index (Cope)	2	1	35	
Hyracotherium vasacciense (Cope)	4		67	
Hyracotherium, cf. *venticolum* Cope		1	4	3
Hyracotherium, possibly *H. cristatum* Wortman	1			
Lambdotherium popoagicum Cope			93	11
Heptodon, cf. *ventorum* (Cope)	1		30	
Heptodon, species		1		4
Hyrachyus, species				1
ARTIODACTYLA:				
Bunophorus, cf. *macropternus* (Cope)			7	
Diacodexis, near *D. secans* (Cope)			1	
Diacodexis, species	2 ‡			
Hexacodus pelodes, new genus and species.			11	
Hexacodus uintensis, new species		1		

† Number of specimens not known and should include material of at least a part of those species listed below which are probably synonyms.
‡ Specimens not seen.

CORRELATION AND AGE OF FAUNAS

Within the formation that may properly be called Knight are clearly three horizons that can be distinguished on the basis of fossil mammalian remains, including the New Fork tongue of Wasatchian material interfingering in the lower part of the Green River series. The lower of these is nearest to Lysite in age and the upper are two distinct zones of Lost Cabin age separated locally by the Fontenelle tongue of Green River. In the absence of evidence of any lower Wasatchian or Gray Bull horizon, except in the Hoback basin (see Dorr, 1952), the Knight may well be regarded as about equivalent to the Wind River series.

Knight station.—Critical examination of the materials derived from the type Knight beds along Bear River lead me to support Granger's (1914, p. 203) conclusion that the horizon there represented is about equivalent to Lysite. The *Cynodontomys* material, as incompletely known, does not appear to be more indicative of a Lysite species than of the later form now known to characterize the La Barge fauna; however, *Hyopsodus browni* is highly suggestive of Lysite and the *Heptodon* material would not appear to be older. The relative frequency with which *Coryphodon* remains have been encountered would appear to have no significance, and although not recorded in the type Lysite they are found in Lost Cabin beds of both Wind River and Green River basins, as well as in the Gray Bull, so that their middle Wasatchian or Lysite representation may well be here. Among the 14 to 16 forms recognized in the fauna, characteristic or peculiarly Gray Bull types are missing, particularly such a dominant form as *Homogalax*. In a like manner, the absence of any representation of Lost Cabin forms as *Meniscotherium* and *Lambdotherium* is equally suggestive. In support of this it should be noted that, with regard to the Lost Cabin equivalent of the Knight in the upper Green River basin, almost a third of the specimens encountered are of one or the other latter forms. In a cursory examination of the upper Knight the percentage of these forms would, because of their size, appear to be even much higher.

Fossil.—The rather limited fauna represented by the small collection from near Fossil, Wyo., is less clearly diagnostic with respect to the horizon represented than is the Bear River Knight. Comparison with horizons of the Wind River and Big Horn basins leaves much to be desired; nevertheless, its closest affinity is with the type Knight. *Heptodon,* taken into consideration with other similarities to the fauna from the Knight on Bear River, tend to restrict comparison to only the middle and perhaps upper Wasatchian levels. On the other hand the species of *Diacodon* and *Hexacodus* represented are distinctly not those found in the Lost Cabin equivalent of the Knight in the Green River basin, and *Hexacodus* is not among the rarer forms represented in the latter beds. *Phenacodus primaevus,* though found at a somewhat lower level than other materials from the Fossil area, is significantly absent from the La Barge fauna. It must be noted, however, the situation with respect to *Phenacodus* is reversed in the Wind River basin. Individually, the elements of the Fossil fauna are inconclusive, but collectively there is a strong presumption toward the Lysite level as that level is indicated by the Knight fauna obtained from the Bear River section.

La Barge.—There would appear to be no doubt of the general equivalance of the La Barge fauna to the Lost Cabin of the Wind

River basin. There is a specific difference between them in many of the genera mutually represented, but this may be largely environmental, or possibly of some small time significance if within a rapidly evolving group. Such a time difference, however, would not be of the magnitude of that between Lysite and Lost Cabin. The Lost Cabin equivalance is indicated by the presence of such genera as *Notharctus, Meniscotherium,* and *Lambdotherium* which first appear, or reach the indicated development, in the Lost Cabin horizon of the Wyoming lower Eocene; by such species as *Esthonyx,* cf. *acutidens; Notharctus venticolus; Absarokius noctivagus; Ambloctonus,* cf. *major; Sinopa vulpecula; Miacis,* cf. *latidens; Hyopsodus mentalis; Hyopsodus wortmani; Hyracotherium,* cf. *venticolum;* and *Lambdotherium popoagicum* which are close or identical to such species more or less characteristic of Lost Cabin in the Wind River or Big Horn basins; and by the developmental stage reached in such species as *Cynodontomys knightensis, Notharctus limosus,* and *Prolimnocyon elisabethae* which are otherwise distinct from related Lost Cabin species.

Suggestive of perhaps a slightly earlier stage than type Lost Cabin, although as noted above these differences may be no more than environmental in nature, are the following: The smaller size, though equivalent dental development, of *Cynodontomys knightensis* in comparison with *Cynodontomys scottianus* in a sequence of species increasing in size; the smaller size and relatively smaller premolars in *Notharctus limosus* than in *N. nunienus;* the weaker hypocone in upper molars of *Notharctus venticolus* of the La Barge fauna; the smaller size (of questionable significance) of *Diacodon pineyensis; Esthonyx,* cf. *acutidens; Absarokius noctivagus; Prolimnocyon elisabethae; Sinopa vulpecula; Didymictis altidens; Viverravus lutosus;* and *Vulpavus asius* in comparison with the same or equivalent Lost Cabin species; and the presence of *Paratetonius?, Thryptacodon,* and *Hyracotherium index.* The above would appear to be of perhaps trifling importance in consideration of relative ages, but on the other hand there is even less to suggest a later stage than type Lost Cabin, although such might be interpreted from the presence of *Sciuravus, Tillomys,* and *Hexacodus.* The evidence for a slightly older age afforded by *Meniscotherium* is perhaps the most interesting, inasmuch as the large *M. robustum* so far not found outside of the Green River basin occurs stratigraphically below *Meniscotherium,* cf. *chamense* of the New Fork tongue. Only the smaller species, regarded as *M. chamense,* is recorded from the Lost Cabin beds of the Wind River basin.

The following tabulation is a comparison of genera now known in the La Barge and Lost Cabin faunas:

	La Barge	*Lost Cabin*
Peratherium	X	
Diacodon	X	X
Parictops		X
Didelphodus		X
Palaeosinopa		X
Cynodontomys	X	X
Esthonyx	X	X
Notharctus	X	X
Loveina		X
Shoshonius		X
Tetonius		X
Paratetonius?	X	
Absarokius	X	X
Stylinodon	cf.	X
palaeanodont		X
Tubulodon		X
Pentapassalus	X	
Paramys	X	X
Sciuravus	X	
Tillomys	X	
Mysops		X
Thryptacodon	X	
Oxyaena	X	X
Protopsalis		X
Ambloctonus	X	X
Prolimnocyon	X	X
Sinopa	X	X
Didymictis	X	X
Viverravus	X	X
Uintacyon	X	
Miacis	X	X
Vulpavus	X	X
Phenacodus		X
Ectocion		X
Meniscotherium	X	X
Hyopsodus	X	X
Coryphodon	X	X
Bathyopsis		X
Hyracotherium	X	X
Lambdotherium	X	X
Eotitanops		X
Heptodon	X	X
Hyrachyus		X
Bunophorus	X	X
Diacodexis	X	X
Hexacodus	X	

New Fork.—The New Fork tongue, separated by Green River beds called the Fontenelle tongue by Donovan (1950) from the Knight along the Green River, has yielded a faunal representation which compares equally well with that of the Lost Cabin, but includes forms not found in the La Barge fauna. The Lost Cabin age is here indicated by *Ambloctonus,* cf. *major; Hyopsodus wortmani; Meniscotherium,* cf. *chamense;* cf. *Bathyopsis fissidens; Hyracotherium,* cf. *venticolum;* and *Lambdotherium popoagicum.* The significant differences to be noted from the La Barge fauna are in (1) the species of *Meniscotherium* represented, (2) the presence of *Bathyopsis?* instead of *Coryphodon,* and (3) the appearance of *Hyrachyus.* I suspect that, were the New Fork better known, *Eotitanops* would be represented, also *Trogosus,* which is known from the Cathedral Bluff tongue in the northwestern part of the Red Desert.

The most significant feature of the discovery of the New Fork fauna is the clear demonstration that the lower beds of the Green River are actually Lost Cabin Wasatchian in age and that the Lost

Cabin fauna can be largely broken up into two stages. Tentatively the lower stage may be regarded as characterized by *Meniscotherium robustum* and *Coryphodon* and the upper stage by *Meniscotherium chamense, Hyrachyus,* species, and possibly *Bathyopsis.* Osborn early regarded the Lost Cabin as comprising two stages, but believed them to be distinguished by *Lambdotherium* and *Eotitanops,* respectively; however, *Lambdotherium* is here found in both levels. Much more of the New Fork fauna needs to be known for a more complete understanding of Lost Cabin zones. This may come when the Cathedral Bluff fauna currently under study by William Morris is placed on record.

ISOLATED OCCURRENCES TO THE EAST OF THE BRIDGER BASIN

Not included in the foregoing tabulation and correlations, and for the most part omitted from consideration in the systematic treatment of the faunas, are the scattered occurrences in the eastern part of the Bridger basin, around the Rock Springs uplift, in the eastern part of the Washakie and Great Divide basins, and in the Red Desert. It is not certainly known but entirely probable that the formation represented by these occurrences is also Knight. An examination of the geologic map of Wyoming leads to the conclusion that the Eocene basin of deposition is the same for these deposits as for those in the vicinity of La Barge and Big Piney, and that the formation is continuous beneath the Green River and Bridger formations, and around the Rock Springs uplift to these widely separated areas.

The more significant of these localities are discussed below:

Rock Springs.—West side of Rock Springs uplift, near fork of Bitter Creek and Little Bitter Creek, about 4 miles southwest of the city of Rock Springs, collected by R. W. Brown in secs. 7, 8, 17, and 18, T. 18 N., R. 105 W.: *Meniscotherium robustum* and *Coryphodon,* species. The rather fortuitous discovery of these forms in the relatively thin zone of Wasatchian beds between Rock Springs and Green River is highly indicative of the upper Knight or La Barge equivalent of Lost Cabin being represented here between Paleocene and Green River strata.

Vermilion Creek.—South of Rock Springs uplift on a tributary to Vermilion Creek (in type Vermilion Creek of King and type Hiawatha of Nightingale) near line between T. 11 N. and T. 12 N., in R. 101 W., northernmost part of Moffat County, Colo., collected by writer: Insectivore, possibly *Diacodon; Paramys bicuspis;* and *Hexacodus,* cf. *pelodes.* The insectivore found here is not significant.

Paramys bicuspis, according to A. E. Wood, who identified the specimen, is suggestive of Lysite; however, *Hexacodus,* cf. *pelodes* would suggest an equivalence with the La Barge fauna.

Black Buttes.—East side of Rock Springs uplift, near Black Buttes, collected in part by Cope and in part by a collector for Marsh: *Coryphodon armatus* and *Hyracotherium pernix.* These give little information other than a Wasatchian age.

Dad-Baggs.—East side of Washakie basin, exposures along highway beneath Tipton tongue, between Dad and Baggs, Wyo., collected by the writer: *Coryphodon,* large species, and *Hyracotherium,* cf. *vasacciense.* A small lot of material from near Baggs was collected by Reeside and Eby in 1924, but this material is not now in the collections. Another collection from near Dad was designated by Wood et al. (1941, p. 18) as "Dad local fauna" and noted by McGrew (1951, p. 54) as having been collected by J. LeRoy Kay for the Carnegie Museum. Of the materials collected by Kay only *Hyracotherium* was mentioned. Of the materials which I have observed none are particularly diagnostic; however, I am inclined to regard the horse as of Knight age rather than lower Wasatchian. It should be noted that Wood et al. (1941, chart) regard the fauna as late Wasatchian. This was based on evidence that I have not examined.

Great Divide basin.—About 18 miles west of Rawlins, Wyo., and about 12 miles northeast of Creston, SE¼SE¼ sec. 32, T. 22 N., R. 90 W., Sweetwater County, collected by E. E. Smith and A. C. Veatch in 1907 while with the U. S. Geological Survey on the North Rawlins Coal field: *Esthonyx,* cf. *acutidens;* cf. *Notharctus venticolus; Coryphodon,* species; and cf. *Heptodon,* species. The materials from this locality in the Great Divide basin are very fragmentary, but cf. *Heptodon* suggests Knight, and *Esthonyx,* cf. *acutidens,* and cf. *Notharctus venticolus* would appear to place the horizon represented in the upper Knight or Lost Cabin equivalent. This occurrence is very near the eastern limit in Wyoming of beds which may be called Knight, still within the Eocene basin of deposition which includes the Bridger basin proper.

Cathedral Bluff tongue.—Northwest part of Red Desert, NW. part of T. 26 N., R. 98 W., collected by R. L. Nace (1939, pp. 17, 26-27) from 75 feet below top of Cathedral Bluff tongue, and identified by Simpson: *Trogosus* or *Tillotherium.* As Simpson has indicated, the evidence is rather strong for a Bridger age. However, I am inclined to regard the Cathedral Bluff and New Fork as equivalent, inasmuch as so marked a retreat of Lake Gosiute as indicated by these tongues would effect the entire periphery, unless complicated by tectonic activity involving tilting or folding. In any case there is presumptive evidence favoring contemporaneity of the occurrences of an extensive tongue of variegated beds encountered interfingering with the lower part of the Green River series in various parts of this basin. This leads to the conclusion that the Cathedral Bluff was deposited during Lost Cabin time and that *Trogosus* may well have appeared before the Bridgerian stage, much as *Hyrachyus,* and have lived as a contemporary of *Esthonyx.*

GEOLOGIC RELATIONS

Sequence of formations.—The sequence of early Tertiary materials in the southwestern part of Wyoming includes as its lowest unit the Evanston; above this the Wasatch group, consisting, as redefined by Veatch (1907, p. 88), of the Almy, Fowkes, and Knight, is followed by the Green River and Bridger formations. To the east of the Bridger basin, around the Rock Springs uplift and along the eastern margin of the Tertiary basin, as shown by R. W. Brown (1949), Paleocene beds generally designated as "Fort Union" are exposed, but whose exact age is not known, having so far produced no known fossil mammal remains. Washakie beds, overlying Green River in the Washakie basin, are equivalent to the upper part of the Bridger and include beds regarded as somewhat later than typical Bridger. To the south of the Rock Springs uplift, in the basin of Vermilion Creek, the Vermilion Creek beds of King, as defined by his map (1876, atlas map 2) are approximately equivalent to the Wasatch of Hayden. The Vermilion Creek includes Paleocene in the vicinity of the Rock Springs uplift, and the Tipton and Cathedral Bluff tongues as well as Knight. The Hiawatha of Nightingale (1930, p. 1023) in the same general area is in a general way equivalent to the Knight. In the northern part of the Bridger basin Donovan's (1950) Fontenelle tongue of Green River is likely equivalent to the Tipton tongue farther south, and as noted above, his New Fork tongue of variegated beds likewise may be Cathedral Bluff tongue, although the identity of these is yet to be proved. Still farther north in the Hoback basin, beds which Schultz (1914) mapped as Evanston and undifferentiated Eocene, and called Hoback formation by the University of Michigan field parties, have produced a Tiffanian and Wasatchian fauna (Dorr, 1952). The equivalence of these beds with others in the Bridger and Fossil basin to the west has not been established. The supposition is that the Paleocene portion may be equivalent to the Evanston, or possibly to a part of the Almy. The Wasatchian horizon may be lower Knight, or possibly Fowkes. It is noted, however, that neither Evanston nor Fowkes were recognized by Veatch or Schultz elsewhere along the western margin of the Bridger basin. Should the beds carrying the Wasatchian fauna in the Hoback basin prove to be a part of the Knight this would then be the only known place where beds which appear to be lower Wasatchian in age are included in the formation.

Relations between basins.—The geologic relations involved in the present study are largely those which exist between the sequence of continental early Tertiary deposits in the upper Green River or Bridger basins, and those in the small, north-south elongated basin which includes the type Knight. The latter, which will be referred to as the Fossil basin, lies in a general way to the west of Oyster Ridge and includes the high plateau area from the upper reaches of Ham's Fork in the north southward beyond the headwaters of Bear River. On the west it is bounded by the intermittent band of pre-Tertiary rocks extending in a general way from Tunp Range in the north to beyond Evanston southward.

Early Tertiary deposition in these two basins appears to have been entirely separate and independent. As we may see from Veatch's (1907) map and sections, the Almy, Knight, and Green River lap successively onto older rocks along both the eastern and western margins of the Fossil basin, and along the western margin of the Bridger or Green River basin, wherever the relation is not actually one of faulting. And although the pre-Tertiary is much folded and faulted in the exposed bands along the east and west margins of the Fossil basin, the Tertiary sediments are for the most part but gently warped or tilted. However, it is evident that the Laramide activity did not completely cease by lower Eocene time so that it would be unsafe to assume that there was entire synchroneity beween the deposits of the Fossil and Bridger basins. This lack of equivalence is more noticeable between the Fossil basin and that next toward the west, in the absence of the Fowkes and in a scant representation of Evanston in the Fossil sequence. It is probable, therefore, that the Knight to the east and that to the west of Oyster Ridge are not entirely equivalent and may have had somewhat earlier or later beginnings and endings, although I suspect a rather general equivalence.

The same may be said of the Green River series which in the two basins was deposited in entirely separate lakes. The ultimate reason for the existence of these two lakes may be the same, or their origins may be tied to the same structural or orogenic control, but again their upper or lower limits may not be entirely contemporaneous in the two basins.

The evidence presented by the fossil mammals in the Knight beds of the two basins is such as to suggest that the upper limit of the Knight may have been as much different as the interval between Lysite and Lost Cabin time. The Lost Cabin fauna in the upper Green River basin extends from a few tens of feet below the Green River to 100 or more feet, whereas in the Fossil basin so far only a Lysite fauna has been certainly recognized. In the vicinity of the town of Fossil, the fauna represented is thought to be equivalent to that of the Lysite as represented by the type Knight farther south, and was likewise found 40 to 100 feet below Green River beds. This reasoning also leads to supposition that the Green River beds in the Fossil basin may include somewhat older strata than in the Green River basin, and that this lake had its origin somewhat earlier in lower Eocene time.

Should a further and more intensive search of the Fossil basin demonstrate beyond doubt the absence of beds of Lost Cabin age immediately underlying the Green River, or interfingering with Green River to the southward, one might argue the advisability of selecting a distinct formation name for beds called Knight in the Green River basin. I would not, however, venture to make such a discrimination, as the lithology is similar and in all probability there is more or less overlap if not precise or complete equivalance in time. Continental deposits are often not clearly definable units, and, of course, notoriously unreliable both as to time and lithology when traced laterally for any considerable distance, even within the same basin of deposition.

SYSTEMATIC DESCRIPTION OF THE MAMMALIA

MARSUPIALIA

DIDELPHIDAE

PERATHERIUM EDWARDI,[2] new species

Plate 1, figures 3, 4

Type.—Left ramus of mandible with last two molars, U.S.N.M. No. 19200.

Horizon and locality.—Upper Knight beds, La Barge fauna, SW¼ sec. 33, T. 32 N., R. 111 W., 12 miles north of Big Piney, Sublette County, Wyo.

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[2] Named for G. E. Lewis, who first called my attention to the particular locality which has since yielded all the *Peratherium* material from these beds.

Description.—Size significantly smaller than *Peratherium comstocki* Cope (1884, pl. 25a, fig. 15) from the "Wind River" beds, nearer that of *Peratherium marsupium* Troxell (1923b) from the Bridger beds. Cusps of last two molars sharp and well defined, particularly the entoconid and hypoconulid which in the last molar are much better defined than in *P. marsupium,* as represented by National Museum materials. Length M_2-M_3, 5.5 mm. Transverse diameter of penultimate molar, 1.8 mm.

A left maxillary portion, U.S.N.M. No. 19206, of a small marsupial found at the same locality is referred to *Peratherium edwardi.* The specimen retains the last two molars, which occlude well with those of the type. The teeth are rather well worn and show little of diagnostic value. The external margin of the penultimate tooth shows three small, worn, but about equally well-defined stylar cusps between the distinct parastyle and metastyle at the angles at the tooth. There appears, however, but two stylar cusps between the more conspicuous parastyle and metastyle on the last molar. In *Peratherium innominatum* Simpson (1928) material in the National Museum collections from the Bridger, a relatively greater spread between the metastyle and the preceding stylar cusp is noted in the penultimate and antepenultimate molars. Length of last two upper molars combined, 4.3 mm. Transverse diameter of penultimate upper molar, 3.1 mm.

PERATHERIUM CHESTERI,[3] new species

Plate 1, figure 1

Type.—Right ramus of mandible with penultimate molar, U.S.N.M. No. 19199.

Horizon and locality.—Upper Knight beds, La Barge fauna, SW¼ sec. 33, T. 32 N., R. 111 W., 12 miles north of Big Piney, Sublette County, Wyo.

Description.—Smaller than hitherto known species of *Peratherium* from the Eocene. A little smaller than the Bridger species *Peratherium innominatum* Simpson (1928). Penultimate molar length about 1.4 mm. and width about 0.8 mm. The alveoli of the last three molars measure about 4 mm. Trigonid relatively high and talonid small with entoconid and hypoconulid much less prominent than in the larger *P. edwardi.* The tooth has points of resemblance to an insectivore but the character and position of the hypoconulid and anterior cingulum seem certainly marsupial.

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[3] Named for Chester Gazin, who collected the type specimens of both *P. edwardi* and *P. chesteri.*

INSECTIVORA

LEPTICTIDAE

DIACODON PINEYENSIS,[4] new species

Plate 1, figure 2

Type.—Left ramus of mandible with M_1 to M_3 and part of P_4, U.S.N.M. No. 19204.

Horizon and locality.—Upper Knight beds, La Barge fauna, SW¼ sec. 33, T. 32 N., R. 111 W., 12 miles north of Big Piney, Sublette County, Wyo.

Description.— Size near *Diacodon alticuspis* Cope (1875, pp. 11-12) but with lower molar teeth slightly shorter and distinctly broader. P_4 much larger. Length of molar tooth series 8.3 mm., shorter than in *Parictops multicuspis* Granger (1910, pp. 250-251) or *Diacodon bicuspis* (Cope) (1880a, p. 746; see also Matthew, 1918, p. 575). Also, lower jaw much shallower than in either. *Diacodon pineyensis* is appreciably larger than *Diacodon tauri-cinerei* Jepsen (1930, pp. 124-126) from the lower Gray Bull beds.

Discussion.—A sufficient portion of the heel of P_3 is preserved in U.S.N.M. No. 19203 to show that the Knight species is *Diacodon* rather than *Parictops.* Moreover, absence of a fourth diminutive cusp on the heel of the molars is further evidence supporting reference to *Diacodon.*

In critically examining the type of *Diacodon alticuspis,* I find that the preserved portion of P_4 is quite unlike this tooth in *Diacodon bicuspis, D. tauri-cinerei,* or *D. pineyensis.* The decidedly short P_4 with its narrow, much reduced talonid in *D. alticuspis* might justify resurrecting the generic name *Palaeictops* for *D. bicuspis,* etc. Matthew's reasons for first erecting[5] and then dropping the name *Palaeictops* are not given. However, the differences here noted are as great as, if not greater than, those between *Parictops multicuspis* and *Diacodon bicuspis.* I (1949, p. 221) earlier regarded *Parictops* as probably valid, but the significance of its characters may be no greater than those which seem indicated for *Palaeictops.* It should be noted, moreover, that in the character of P_3 *Diacodon tauri-cinerei* makes a distinct approach toward *Parictops multicuspis.* It is anticipated that new collections currently being made by Dr. Simpson from the San Jose formation in New Mexico will reveal additional material of *Diacodon alticuspis* so that this form will be more clearly defined and the genus better understood.

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[4] Named for the town of Big Piney, Wyo.

[5] Granger (1910, p. 250) has incorrectly attributed this genus to Cope.

DIACODON, cf. ALTICUSPIS Cope

There is in Princeton's collection, from about 100 feet below Green River beds, 3 miles northwest of Fossil, Wyo., a lower jaw portion, P.U. No. 16171, representing a species of *Diacodon* very close to *D. alticuspis* Cope. The species is clearly not *Diacodon pineyensis*. Compared to the latter the cheek teeth are narrower, particularly the talonids, and the paraconid is placed lower with respect to the much elevated protoconid and metaconid. The narrowness of the talonid is most emphasized in P_4 in which the entoconid is much subdued and the basin restricted. The teeth, except for P_4, are slightly larger than in *D. tauri-cinerei* and the trigonids of the molars are higher, except for the paraconid, and broader. Comparison with *D. alticuspis* suggests a close relationship, but one which is inconclusive owing to the fragmentary nature of the type.

MIXODECTIDAE

CYNODONTOMYS KNIGHTENSIS,[6] new species

Plate 2, figure 1

Type.—Left ramus of mandible with P_4-M_3, U.S.N.M. No. 19314.

Horizon and locality.—Upper Knight beds, La Barge fauna, SW¼ sec. 33, T. 32 N., R. 111 W., 12 miles north of Big Piney, Sublette County, Wyo.

Description.—Size close to that of *Cynodontomys latidens* Cope (1882a, pp. 151-152), much smaller than more nearly contemporaneous *Cynodontomys scottianus* (Cope) (1881a, pp. 188-189). P_4 with paraconid distinct and low, and with metaconid almost as large as protoconid and well separated from it though not so much so as in *Microsyops*. Talonid of P_4 broad and fully molariform, though slightly narrower than in molars, with protoconid, entoconid, and hypoconulid sharp and well defined. P_4 distinctly more progressive than illustrated (Matthew, 1915c, figs. 45, 46) for *Cynodontomys latidens* Cope.

Discussion.—In all there are 13 specimens of this form, all but one are lower jaws and, except for two, are from the same exposures as the type. One lower jaw and an isolated upper molar were obtained southeast of Big Piney, on the east side of the Green River. This interesting species, except for its smaller size, is as fully developed as *Cynodontomys scottianus* in the progressiveness of its fourth lower premolar, as might be expected in this horizon. *Cynodontomys scot-*

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[6] Named for the Knight formation.

tianus, however, is not represented in this fauna, nor is the relatively gigantic *Cynodontomys lundeliusi* White (1952, pp. 191-192) from the Lost Cabin beds in the Boysen Reservoir area. Though *C. knightensis* and *C. scottianus* are from distinctly separate basins of deposition during upper Wasatchian time, the geographic distance between the occurrences is not particularly great. It seems probable that the difference in species is to be attributed to ecologic differences.

MEASUREMENTS OF TYPE LOWER JAW OF
Cynodontomys knightensis, NEW SPECIES, U.S.N.M. NO. 19314

	mm.
P_2 (alveolus) to M_3, incl.	20.5
P_4 to M_3, incl.	15.2
M_1 to M_3, incl.	11.5
Depth of jaw beneath M_2 (internally)	7.3

CYNODONTOMYS, species

A portion of a left lower jaw including M_2 and M_3, in the collections of the American Museum, from the bluffs of the Bear River south of Knight station is identified as *Cynodontomys.* M_2 in this specimen has the same proportions as in *C. knightensis,* but M_3 is relatively a little shorter as in *Cynodontomys angustidens.* This specimen, A.M. No. 12836, has been labeled *Cynodontomys latidens?* but in the absence of P_4 the progressiveness of the dentition cannot be clearly determined. An unusual feature of the specimen is the remarkable flange-like development of the outward- and forward-turned anterolateral margin of the ascending ramus. An approach to this condition is seen in the prominence of this crest in certain of the specimens of *C. knightensis.*

TILLODONTIA

ESTHONYCHIDAE

ESTHONYX, cf. ACUTIDENS Cope

Two incomplete, isolated upper molars from variegated beds between Big Piney and La Barge, Wyo., and a single lower molar from 12 miles North of Big Piney, may well represent the species *Esthonyx acutidens* Cope (1881a, pp. 185-186). The lower tooth is complete and little smaller than in the type of *E. acutidens.* There is much variation in size of *Esthonyx* material from the Lost Cabin beds but the average is distinctly larger than the older *E. bisulcatus;* moreover, the posterior wall of the trigonid of the lower molars tends to be somewhat less oblique and the talonid basin a trifle larger in *E. acutidens.*

In passing it should be noted that the type of the species, *Esthonyx spatularius,* erroneously recorded as coming from the Wind River beds, is beyond reasonable doubt from the Gray Bull beds of the Big Horn basin. The history and explanation of this error are covered in manuscript now in preparation on the tillodonts, and briefly stated in this paper under the section on *Didymictis.*

ESTHONYX, species

The outer portion of an upper molar in the Knight station material in the American Museum is recognized as belonging to *Esthonyx.* The specimen is too incomplete to warrant specific comparison. An upper molar tooth in the collection from the New Fork tongue also represents *Esthonyx.* The latter tooth is short anteroposteriorly and relatively wide transversely. I am uncertain as to whether or not it is *Esthonyx acutidens.*

PRIMATES

ADAPIDAE

PELYCODUS? species

A fragment of an upper molar, including only the outer half, in the American Museum collection from the Knight beds near Knight station in southwestern Wyoming, is only slightly larger than M^2 in *Notharctus limosus* described below, but has the mesostyle no better developed than in *Pelycodus,* hence is referred tentatively to the latter genus.

NOTHARCTUS LIMOSUS,[7] new species

Plate 1, figures 6-8

Type.—Portions of both rami of the mandible with left P_3-P_4, and right M_1-M_3, inclusive, U.S.N.M. No. 19294.

Horizon and locality.—Upper Knight beds, La Barge fauna, SW¼ sec. 33, T. 32 N., R. 111 W., 12 miles north of Big Piney, Sublette County, Wyo.

Description.—Size of molars a little less than in *Notharctus nunienus* (Cope) (1881a, p. 187) with premolars much smaller and depth of jaw less, particularly beneath premolars. P_4 with metastylid well developed and broadly spaced from protoconid. Upper cheek teeth anteroposteriorly short, most noticeably in the medial and lingual portions. Molars relatively broad transversely with distinct mesostyle and hypocone on M^1 and M^2.

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[7] From Latin *limosus,* muddy, with reference to Muddy Creek where the type was found.

Discussion.—The smaller of the notharctine primates in the La Barge fauna is represented by about 24 specimens, the majority of which were obtained from exposures about 12 miles north of Big Piney.

The lower molars average noticeably smaller in size than those in American Museum specimens of *Notharctus nunienus* from the Lost Cabin beds, and in only two specimens are teeth found as large as in the smallest of *N. nunienus.* The length of M_2, for example, has a range of from 4.9 to 5.3 mm. in *N. nunienus,* and in *N. limosus* the range would be 4.3 to 4.7 mm. except that one specimen measures 5.0. The average in the two species is 5.2 and 4.6 mm., respectively. The molar teeth are otherwise not particularly distinctive. The paraconid is strong on M_1, but highly variable on M_2 and M_3. M_3 has two cusps in the position of the hypoconulid much as in *N. nunienus,* although this has been noted also in *Pelycodus.*

The difference in size of premolars is more noticeable, and P_3 in particular is relatively much smaller than in *N. nunienus.* P_4, though of distinctly smaller size than in *N. nunienus,* has a metaconid that appears to be relatively more widely separated from the protoconid and exhibits a conspicuous, sharply conical hypoconid. This cusp is also distinct on P_3. In *N. nunienus* material the accessory cusp or hypoconid on P_3 and P_4 is generally weak or blunt. In one specimen of *N. nunienus,* A.M. No. 4736, a rather distinct entoconid was observed on P_4. A rudiment of such a cusp was noted in U.S.N.M. No. 19290 of *N. limosus.*

A well-preserved maxillary portion, U.S.N.M. No. 19293, of *Notharctus limosus,* includes P^3 to M^3. The upper teeth are noticeably less in their fore and aft dimension, taken through their middle and lingual portions, in comparison with A.M. No. 4735 of *N. nunienus,* giving them a less rounded appearance, but they are nearly as wide transversely. As in *N. nunienus,* the mesostyle is distinct on M^1 and M^2, and somewhat weaker on M^3. The hypocone is as well developed on M^1 and M^2, but obscured through wear on M^3.

MEASUREMENTS OF TYPE LOWER JAW OF

Notharctus limosus, NEW SPECIES, U.S.N.M. NO. 19294

	mm.
M_1 to M_3, incl.	14.4
P_3,[8] anteroposterior diameter: greatest transverse diameter	2.9: 2.0
P_4, “ “ “ “ “	4.0: 2.7
M_1, “ “ “ “ “	4.5: 3.3
M_2, “ “ “ “ “	4.4: 3.8
M_3, “ “ “ “ “	5.8: 3.5

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[8] The type specimen is at the upper limit for the sample in size of premolars.

NOTHARCTUS VENTICOLUS Osborn

The larger of the notharctine primates in the La Barge fauna is represented by a maxilla, U.S.N.M. No. 19288, with P^4-M^3 and five lower jaws. The size of the teeth in these specimens corresponds well with those of *Notharctus venticolus* Osborn (1902, p. 195). In the upper molars the mesostyle is prominently displayed, but the hypocone, though apparently well developed on M^1, appears subdued on M^2. It is evident, however, that somewhat greater wear would produce a large distinct lake in this position. The lingual portions of all the upper teeth preserved in this specimen appear relatively broader anteroposteriorly than in the *N. limosus* maxilla. P^4 and M^3 are distinctly less nearly triangular.

ANAPTOMORPHIDAE

ABSAROKIUS NOCTIVAGUS Matthew

This species is apparently represented in the La Barge fauna materials by three lower jaw portions, one of which, U.S.N.M. No. 19198, exhibits Dp_4 with what appears to be P_2, as well as P_4 and M_3, just erupting. The first two molars are in position but unworn. If one may judge by the positions of the two erupting premolars, P_3 is yet buried beneath the long slender roots of Dp_3. Two small alveoli anterior to the erupting P_2? are presumably for incisors, or incisor and canine. There is no evidence for an enlarged front tooth as in *Tetonius*. Matthew (1915c, pp. 463-465) was apparently correct in his interpretation of the condition in *Absarokius abbotti* (Loomis) and fully justified in distinguishing *Absarokius*.

The teeth in No. 19198 compare very closely to those in the type of *A. noctivagus* but are very slightly narrower. In U.S.N.M. No. 19196, M_3 is a little smaller than in this type, about the length but not so slender as in a specimen of *Absarokius abbotti* in the American Museum collections. A third specimen in the collections from north of Big Piney, U.S.N.M. No. 19197, includes an M_3 a little larger than in the type of *A. noctivagus,* and the paraconid of this is much less lingual in position. It is possible that the latter specimen does not represent this genus.

PARATETONIUS? SUBLETTENSIS,[9] new species

Plate 1, figure 5

Type.—Left ramus of mandible with P_4-M_2, inclusive, preserved, U.S.N.M. No. 19205.

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[9] Named for Sublette County, Wyo.

Horizon and locality.—Upper Knight beds, La Barge fauna, SW$\frac{1}{4}$ sec. 33, T. 32 N., R. 111 W., 12 miles north of Big Piney, Sublette County, Wyo.

Description.—Size smaller than *Paratetonius? tenuiculus* (Jepsen) (1930, p. 126), much smaller than *Paratetonius musculus* (Matthew) (1915c, p. 463) or *Paratetonius steini* Seton (1940) from the older Gray Bull or Lysite horizons. P_4 not enlarged but exhibiting a well-defined paraconid, a weak but distinct metaconid, a short but broadly basined talonid with but a very weak posterointernal cusp or entoconid and a somewhat better-defined posteroexternal cusp or hypoconid. Molar cusps more marginally placed than in *Tetonius,* as observed by Seton for *Paratetonius.* Paraconids lingual in position, and in M_2 clearly defined and close to the metaconid. As shown by alveoli, P_3 is two-rooted, not fused as in *P. musculus,* and P_2 apparently has but a single large root, relatively larger than in *P. musculus.* Anterior to the root of P_2 is a very small but deep alveolus, probably for P_1, but possibly for an anterior root of P_2, posteroexternal to the relatively large alveolus presumed to be that of the canine.

Discussion.—As anticipated by Matthew in his description of *Tetonius musculus, Paratetonius* Seton appears to be a clearly distinct group, less specialized than *Tetonius,* and including forms in all horizons of the Wasatchian stage. The latest of these, *Paratetonius? sublettensis,* if correctly referred, is the smallest and in some respects may be the least specialized.

In addition to the probable dental formula, the moderate-sized, relatively low-crowned P_4 implies less progressiveness than, for example, *Tetonius homunculus.* On the other hand, the form of P_4 is distinctly more progressive in its approach to that of the molars, a quite different trend.

It is interesting to note that Loomis's form, *Anaptomorphus minimus* (1906, p. 278), from Gray Bull beds of the Big Horn basin, appears scarcely to have been mentioned since its description, except for having been placed questionably in synonymy with *Nyctitherium celatum* by Matthew (1918, p. 604). The illustration is not too clear, so that generic reference cannot be verified but in size it may be smaller than *Paratetonius musculus.* The dimensions given by Loomis are slightly less than for lower teeth in a Gray Bull specimen in the National Museum collections, No. 19154, tentatively referred to *Paratetonius? tenuiculus,* but close to those of *Paratetonius? sublettensis.*

MEASUREMENTS OF TYPE LOWER JAW OF

Paratetonius? sublettensis, NEW SPECIES, U.S.N.M. NO. 19205

	mm.
Length, P_4 to M_2, incl.	4.5
Length, M_1 to M_2, incl.	3.2
Width, M_2	1.3
Depth of jaw beneath M_2, internally	3.1

TAENIODONTA

STYLINODONTIDAE

Undetermined stylinodont

Plate 2, figures 2-5; plates 3, 4

The articulated portions of two hind limbs and a fore limb, with feet, and including some vertebrae from exposures of upper Knight 12 miles north of Big Piney, are recognized as representing a taeniodont. No skull or jaw material, except for some finely broken and scattered fragments of teeth, was encountered. So far the only determinable taeniodont material from this horizon is the Lost Cabin *Stylinodon? cylindrifer* (Cope) (1881a, pp. 184-185) from the Wind River basin. It is reasonable to suppose that the La Barge fauna includes that species but this cannot be established on the material at hand.

The finding of this material is indeed fortunate as it gives us information previously not known on the structure of the hind foot in this family, and gives a certain amount of skeletal data none of which had been recorded before from the Lost Cabin stage.

Fore limb.—The limb bones are rather badly crushed and those of the fore limb very incomplete. The greater part of an ulna is preserved and though incomplete distally, so that its length cannot be determined, it resembles rather noticeably the ulna figured by Marsh (1897, fig. 5) for *Stylinodon mirus.*

Fore foot—The fore foot is represented by the scaphoid, pisiform, unciform, the fourth and fifth metacarpals and the distal part of the third, together with the phalanges of the second, third, and fourth digits. The scaphoid is a relatively small triangular wedge with the large proximal or superior facet for the radius, converging forward and medially with the somewhat smaller distal facet. These are separated laterally by a still smaller lenticular facet for the lunar. The angle between the lunar and distal facets is about 90°, but between the lunar and radial facets is much more acute, more as anticipated by Matthew (1937, fig. 66) for *Psittacotherium* than as interpreted in rough outline by Patterson (1949, p. 253, fig. 4c) for *Stylinodon mirus.* It cannot be determined from the material at hand whether the moderate-sized "pear"-shaped distal facet articulated with the trapezium, or, as Patterson suggests, the trapezoid. This bone, however, so very closely resembles the scaphoid in *Trogosus,* the distal facet of which articulates with the trapezium, that a reasonable doubt persists.

The pisiform is deeply expanded dorsoventrally in its posterior portion and anteriorly exhibits a large, concave articular surface for the ulna and ventrally a much smaller facet for the cuneiform. The anterior extremity is expanded medially although this projection is not complete.

The unciform is a relatively large carpal bone which articulates distally with the entire proximal end of the fourth metacarpal. It is incomplete laterally so that the surface for the fifth metacarpal is missing. There is no certain evidence that the unciform was in contact with the third metacarpal. The proximodistally long facet on the medial side of the unciform seems to have articulated only with the magnum as Patterson has shown. Proximally, incomplete facets for the lunar and cuneiform, at a sharp angle to one another, are preserved.

The fourth metacarpal, about 35 mm. in length, is a sturdy bone with broadly expanded extremities, but with a constricted shaft. The articulating surface for the fifth metacarpal is rather broadly arcuate and undercut distally in a somewhat conventional way, but facing distinctly more palmar than in many unguiculate types. The proximal surface is nearly triangular and the broad and deep distal articular surface for the proximal phalanx is evenly rounded dorsoventrally but with almost no evidence of a keel. The 2d and 3d metacarpals are seen to have saddle-shaped distal extremities.

The fifth metacarpal is about two-thirds the length of the fourth and has a moderately robust proximal portion with broad articulation with the fourth metacarpal. A facet is seen for articulation with the unciform but this surface is incomplete in the specimen at hand. The distal portion of the fifth metacarpal is very much reduced with but a very small articular surface for the first phalanx, about half the width of that in the fourth.

The phalanges of the second to fourth digits are broad and deep but much shortened proximodistally. Only the proximal portions of the clawed distal phalanges are present, but these are transversely narrow and extremely deep. The largest of the claws is approximately

18 mm. across the widest part of the base proximally, but is about 38.5 mm. deep.

Hind limb.—The stylinodont hind limb and foot, previously unknown but for the meager foot remains belonging to *Psittacotherium* and very fragmentary limb material of *Ectoganus,* are represented by both right and left sides in the Knight material. In the left limb all elements are included, but the tibial and tarsal portions are rather poorly preserved. The right side is in a much better state of preservation; however, the femur, cuboid, part of the external cuneiform, and the proximal portions of the second and fifth metatarsals are missing. Except for the proximal articulating surface on the second metatarsal and much of the cuboid, these can be interpreted from the left side.

The femur, approximately 220 mm. long as measured from about the crest of the greater trochanter, is crushed and distorted, so that detailed description is not feasible. The head is lacking but the greater trochanter is well developed. It is broadly expanded anteroposteriorly and its roughened external surface extends over 80 mm. distally. There does not appear to be a third trochanter but the lesser trochanter beneath the head, though broken off, was evidently well developed for possibly as much as 50 mm. along the shaft. The distal or condylar portion of the femur though transversely crushed would appear to be narrow and moderately deep anteroposteriorly.

The proximal portion of the tibia likewise appears somewhat crushed transversely. Nevertheless, the proximal extremity may be relatively deep anteroposteriorly and transversely narrow, particularly just below the articular portion. The external articular surface is relatively small and immediately beneath its posterior extremity and facing distally is a facet for the fibula. The inner surface of the proximal portion of the tibia is rather flattened and the internal condyle is much more produced anteroposteriorly than the outer. A prominent ridge extends downward on the posterior margin of the shaft from the external condyle, terminating distally in a prominent and unusual-appearing process[10] about 36 mm. below the articular surface. The anterior margin or cnemial crest slopes more or less evenly toward the distal portion of the shaft with no clearly defined

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[10] This process may well have accommodated in part more than one important muscle. Its direction suggests the *soleus,* participating in the Achilles tendon. However, the groove posterior to the internal malleolus is well developed for the *tibialis posticus* or *flexor longus digitorum,* or both, which also may have originated in part on this process. The flexor muscles were obviously strong, to judge by the claws, and a well-developed *tibialis posticus* might account for a similarly unusual development of the posterointernal margin of the navicular as a point of insertion. The latter muscle would serve as an extensor of the tarsus and in supination of the foot.

lower limit on the material at hand, but the proximal tuberosity stands out ruggedly and well in front of the condylar surfaces. The distal portion of the tibia appears normal and undistorted. The internal malleolus is very well developed and extends downward to cover a large segment of the inner wall of the astragalus. Also, the inner condylar surface of the distal end of the tibia projects much farther posteriorly than the outer.

The fibula is a slender shafted bone with enlarged extremities. Also, the shaft is somewhat curved, longitudinally, with the concavity forward so that the distal extremity or external malleolus is well forward and actually ahead of the tibia. The external malleolus is transversely broad anteriorly and on its inner side exhibits a large and elongate surface facing inward, ventrally, and somewhat posteriorly for articulation with the forward, proximal portion of the external wall of the body of the astragalus.

Hind foot.—The hind foot for the most part has the general appearance of a primitive unguiculate type, but with a combination of distinctive characteristics evidently more or less peculiar to the Taeniodonta. The more notable peculiarities include a transversely, much recurved arrangement of the tarsus and digits. The cuneiforms and proximal extremities of the metatarsals present a triangular aspect so that articulation between them from side to side tends to bring the first and fifth digits relatively close together in a plantar direction. With this arrangement the animal's metatarsals were evidently maintained nearly upright in standing, with the weight to the ground carried largely by the distal extremities of the metatarsals through their large sesamoids, and only in part by the proximal phalanges. It is also interesting to note that the first and fifth digits, though a little shorter than the others, are relatively unreduced, as compared with those of the front feet, and although the various digits diverge noticeably from one another, the first appears to diverge from the second somewhat more sharply. The characteristics of the individual elements of the foot are discussed in more detail below.

The astragalus in proximal aspect rather resembles that in the larger cats, but with the trochlear surface distinctly raised, not continuing more or less smoothly into that of the neck of the astragalus. It is not far from the conception outlined by Matthew (1937, fig. 67) for *Psittacotherium,* although with less anteroposterior extent of the trochlea for the tibia. In plantar aspect, the astragalus is somewhat more distinctive. The large ectal or peroneal facet is less concave than in cats or bears. Posteriorly it converges rapidly with the trochlea rather than extending parallel to it, giving the external wall of the body of the astragalus a triangular rather than lunar outline. Anteriorly the ectal facet turns sharply upward for a short distance. The sustentacular facet is much smaller, slightly concave anteroposteriorly, and elongate, extending from near the navicular facet medially, posteriorly, and plantad with respect to the ectal facet. The head of the astragalus articulates broadly with the navicular and externally in a small part with the cuboid.

The calcaneum is apparently the most distinctive bone in the pes. Its most noticeable characteristic is the dorsoventral expansion of its tuberosity or tuber calcis, recalling on a small scale somewhat the appearance of the posterior margin of this element in certain of the edentates, such as *Hapalops*. Ventrally the expansion projects forward, presumably in part for attachment of the *flexor brevis digitorum* which would be inserted into the second phalanges. Anteriorly the calcaneum exhibits on its superior margin the large ectal facet for the astragalus. Anterior to this and meeting the upturned anterior margin of the ectal facet at a sharp angle is a transversely elongate and concave facet facing forward and medially for the cuboid. The outer surface of the calcaneum is developed anteriorly into a prominent forward projection or process which carries the forward portion of the cuboid facet on its inner surface. The sustentacular portion of the calcaneum is missing.

The navicular is distinguished by its elongation, extending inward well beyond its articulation with the head of the astragalus and the internal cuneiform. The knoblike ventrointernal prominence on the navicular may well represent a sesamoid commonly found in certain groups of mammals on the tibial side of the tarsus, which has here become co-ossified with the navicular. The proximal surface of the navicular is broadly concave with a ventrointernally elongate facet for the head of the astragalus. The external facet for the cuboid is about at right angles to the surfaces for the astragalus and external cuneiform, and moderately short dorsoventrally. Its direction is distinctly acute to that of the dorsal surface of the navicular. Distally, the three facets for the cuneiforms occupy somewhat less than two-thirds the long diameter of the navicular. These facets are of approximately equal width dorsally, but that for the internal cuneiform is the more convex dorsoventrally and turns sharply proximal internally.

Little can be determined of the characteristics of the very poorly preserved cuboid in the left foot; however, from the articular facets of the adjacent bones of the right foot it was clearly of good size. Proximally, it articulated broadly with the calcaneum and extended onto the externoplantar margin of the head of the astragalus. Internally it made contact with the nearly erect and coplanar surfaces of the external walls of the navicular and external cuneiform. Distally, it was evidently broad and covered much of the proximal extremity of the fourth metatarsal and apparently a somewhat larger surface on the fifth metatarsal.

The middle and external cuneiforms are of about equal size and present a nearly rectangular appearance in dorsal view. Their proximal and distal aspects are more nearly triangular, the external cuneiform more so than the middle cuneiform. On their distal surfaces each laps slightly over the next metatarsal external to that directly distal to it. The internal cuneiform is not well preserved but is distinctly larger than the other two. Proximally its articular surface for the navicular is markedly concave and externally it makes contact only with the proximal portion of the inner wall of the middle cuneiform. Distally its articular surface is broad, deep, and slightly convex for the first metatarsal.

The metatarsals are a little shorter, with shafts somewhat constricted, and extremities expanded in comparison with the partial hind foot of *Psittacotherium* figured by Matthew. The first metatarsal is the shortest, about five-sevenths the length of the third metatarsal, but is more robust and the proximal extremity is somewhat larger. The first metatarsal apparently does not articulate with the second. The latter is intermediate in length between first and third metatarsals and has a somewhat broader and flatter shaft than the third. The distal extremity is also a little wider but more compressed toward the first. The third and fourth metatarsals are about the same length, 41 mm., but the fourth metatarsal articulates in a slightly higher position in the foot than the third. The proximal extremities of both are distinctly triangular with the broadest base forward. The shaft and distal extremity of the fourth is slightly wider and shallower than the third. The fifth metatarsal is a little longer than the first, but much less robust, and highly distinctive in appearance. The proximal portion has a wide external flare and the dorsoventrally much-compressed shaft exhibits a much more broadly concave plantar surface than the other metatarsals. The proximal extremity articulates with the full depth dorsoventrally of the external surface of the fourth metatarsal and has a relatively large articular surface for the cuboid. Distally the articulation with the first phalanx is transversely wide but not deep. All the metatarsals show well-rounded distal articulations and sturdy sesamoids, and only the slightest suggestion of a median keel.

The intermediate phalanges of all the digits of the hind foot are much shortened, more so than in *Psittacotherium,* and the proximal of these in digits 2 to 5 are scarcely more than wedges with the thin edge down. Those adjacent to the clawed phalanges show evenly rounded, saddle-shaped articular surfaces distally. The claws are much more robust than in *Psittacotherium,* but not nearly so deep and relatively less compressed transversely than in the fore foot of the Knight individual. Those in the first and fifth digits are fully developed.

EDENTATA

EPOICOTHERIIDAE?

PENTAPASSALUS,[11] new genus

Generic characters.—Dental formula: $I\frac{?}{1}$, $C\frac{1}{1}$, $P\frac{2}{3}$, $M\frac{3}{3}$. Teeth much as in *Tubulodon,* but last premolar and M_2 possessing a single, conical root. M_1 alone of the lower series two-rooted. Cranial portion of skull relatively short and broad, more as in *Epoicotherium* than as in *Palaeanodon* or *Metacheiromys.* Bullae ossified, well inflated and posterior in position. Palate not extended posteriorly and pterygoids not continuous with bullae.

Type species.—*Pentapassalus pearcei,* new species.

PENTAPASSALUS PEARCEI,[12] new species

Text figures 2-4

Type.—Large part of skeleton, including skull and lower jaws, U.S.N.M. No. 20028.

Horizon and locality.—Upper Knight beds, La Barge fauna, east side of Green River, southeast of Big Piney, sec. 14, T. 29 N., R. 111 W., Sublette County, Wyo.

Specific characters.—Size near *Tubulodon taylori,* but with teeth a little smaller and jaw somewhat deeper. Skeletal portions correspond closely in size to those of *Metacheiromys tatusia.* Other specific characters not distinguished from those of the genus.

Material.—The type of *Pentapassalus pearcei* is a somewhat crushed but remarkably complete skull and lower jaws, together with both humeri, portions of both radii, an ulna, femora, parts of the tibiae,

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[11] From Greek πέντε, five, and πάσσᾰλος, a peg; with reference to the five peglike postcanine teeth in the skull.

[12] Named for Franklin L. Pearce, who found the type specimen.

incomplete scapula and pelvis, a few vertebrae, ribs, and foot bones. In addition to the foregoing, there is in the collection a left lower jaw portion, U.S.N.M. No. 19214, with the last molar and the alveolus for the molar immediately preceding, which was found about 12 miles north of Big Piney, Wyo.

Description of skull.—Among living forms the skull of *Pentapassalus pearcei* may best be compared with that of the small Argentine armadillo, *Zaëdyus pichiy* Desmarest, rather than with the peculiar *Chlamyphorus truncatus* or *Burmeisteria retrusa.* In superior view (fig. 2) the cranial portion of the skull of *P. pearcei* is wider, and the rostrum much shorter and less attenuated anteriorly than *Z. pichiy.* The anterior extremity of the rostrum is damaged but its extent can be determined by the nasals and lower jaws. Posteriorly the rostrum

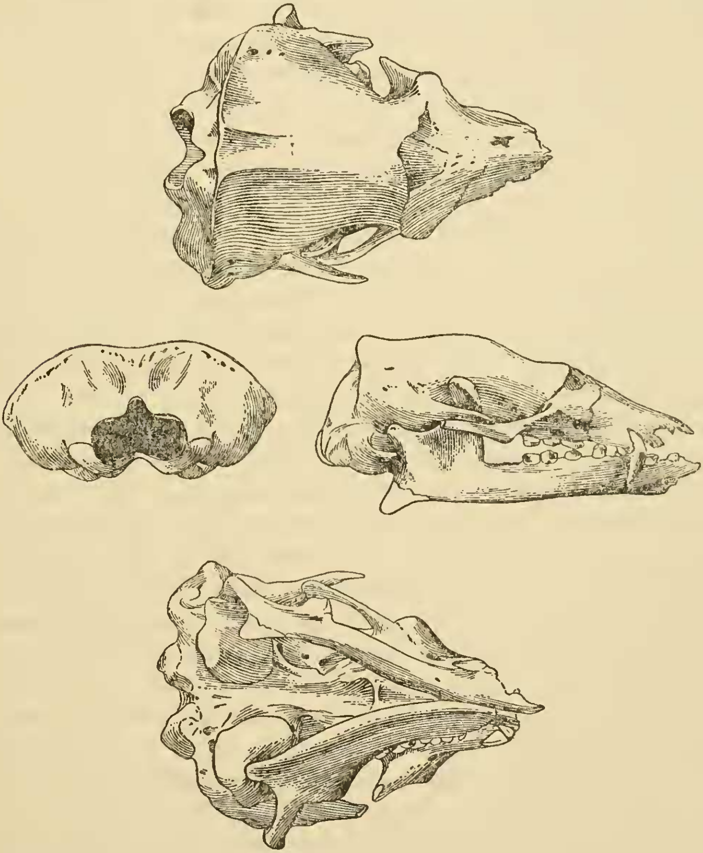

FIG. 2.—*Pentapassalus pearcei,* new genus and species: Skull and mandible (U.S.N.M. No. 20028), type specimen, dorsal, posterior, lateral, and ventral views, natural size. Upper Knight, lower Eocene, Wyoming.

widens abruptly across the frontals, but apparently not to the extent in *Z. pichiy*. The sutures of the fossil skull are for the most part well closed so that no great amount of information on the limitations of the individual bones can be ascertained. However, the indistinct suture between the premaxilla and maxilla appears to curve backward superior to the bulge of the canine. Also, the frontoparietal suture extends almost directly across the cranium at the orbital constriction. There is no sagittal crest, but the weak superior margins of the temporal fossae approach closely and extend nearly parallel fore and aft, somewhat as in *Zaëdyus*. The presence or absence of an interparietal cannot be determined.

In lateral view (fig. 2), the skull of *P. pearcei* exhibits moderate depth posteriorly, relatively a little less than *Zaëdyus pichiy*, but becomes noticeably shallow immediately anterior to the bullae. The midportion of the skull is somewhat crushed, but the basicranium makes a decidedly more acute angle with the palate than in the armadillo or *Orycteropus*. In the latter forms these surfaces are more nearly parallel. The much shorter rostrum in *P. pearcei* does not taper anteriorly so rapidly. The lachrymal portion of the skull is rugged and participates in a marked lateral widening of the skull at the anterior margin of the orbit, much as in *Zaëdyus*, and the lachrymal foramen is conspicuous on the crest of the zygoma immediately beneath a rugose prominence of the lachrymal bone. This foramen is more forward in *Orycteropus* and some material of *Dasypus*. The anterior opening of the infraorbital foramen is large, single, and immediately above M^1. The zygoma is slender with the squamosal portion overlapping the jugal much as in *Orycteropus*. The contact of these elements is quite unlike that in *Dasypus*, and the zygoma is much weaker than in *Zaëdyus*.

In posterior view (fig. 2) the skull is seen to be broad and shallow, actually resembling more closely the much larger *Orycteropus* than any of the armadillos. The resemblance is further emphasized by the way in which the somewhat more inflated mastoid portion is displayed in this view, and in the extension of the well-developed lambdoidal crests outward, above, and lateral to the mastoid prominence. The foramen magnum in *P. pearcei* is notched dorsally somewhat as in *Epoicotherium*.

The ventral aspect (fig. 2) of the *P. pearcei* skull is highly interesting and shows in its anterior part a short, broad palate in contrast to that in armadillos and aardvark. Although somewhat destroyed posteriorly, the palate, as in *Zaëdyus*, apparently did not extend much, if any, posterior to the tooth row. The palatal margin of the posterior narial opening was concave and there is a good indication that it was also curved downward, somewhat as in *Orycteropus.* The pterygoids are partially damaged but apparently turn outward ventrally rather than inward, possibly more so than in *Zaëdyus* or *Orycteropus,* but quite unlike *Dasypus.* The palatopterygoid crests were much longer than in *Zaëdyus,* more as in *Orycteropus* but relatively not so widely separated. These crests also were not continuous with the bullae as in *Burmeisteria* or *Zaëdyus.*

The foramina in the alisphenoid of *Pentapassalus* may not be distinctive, but the identity of all has not been clearly determined. The foramen ovale is in a normal position just above the posterior extent of a subdued lateral sweeping branch of the pterygoid crest. Immediately anterior to the foramen ovale and within the same general depression is a small foramen, noted also by Simpson (1927, p. 289) in *Epoicotherium,* which may be the posterior opening of an alisphenoid canal but is in all probability a venous canal, which extends transversely through the basisphenoid in both armadillos and *Orycteropus.* The presence or absence of an alisphenoid canal cannot be determined in *Pentapassalus* without damage to the skull. It is absent in armadillos and *Orycteropus,* although Gregory (1910, p. 335), following Weber (1904, p. 414), denoted its presence in the latter—a mistaken identification of the foramen ovale, which was corrected in a later edition of Weber's work. Just ahead of the small venous foramen noted above is a circular foramen, somewhat smaller than the foramen ovale which may be a foramen rotundum; however, the position of the alisphenoid-orbitosphenoid suture has not been determined with certainty so that this may well be the sphenoidal fissure. Immediately forward of the latter opening, the bone shows an elongate, natural-appearing margin directed anterodorsally, such as might be expected of the posterior and outer lip of a sphenoidal fissure, but from there forward the orbital cavity is damaged so that the orbital foramen cannot be seen.

The broad basicranium is characterized by the markedly inflated bullae, the medial walls of which are more nearly parallel than in *Zaëdyus.* The anteromedial margin of the bulla is deeply grooved from the medial wall forward to the foramen lacerum medium for the internal carotid. This groove is not covered medially, nor is the bulla perforated ventral and lateral to this position as in *Zaëdyus.* This perforation may well be the eustachian canal in the latter. In *Pentapassalus* the eustachian foramen may be nearly confluent with the foramen lacerum medium ventrally, or be represented by a small opening at the anterior margin of the bulla well separated laterally from the foramen lacerum medium. The external auditory meatus is large and opens immediately beneath the lower extremity of the lambdoidal crest. The glenoid surface for articulation with the lower jaw is well forward from the external auditory meatus and terminates posteriorly in a much-subdued postglenoid process, which carries on its posterior surface a normal postglenoid foramen. In *Dasypus* there is no postglenoid process and the articular surface terminates posteriorly at the opening for the ear. In *Zaëdyus* and *Orycteropus* the postglenoid process of the squamosal is a thin sheet of bone which also forms the anterosuperior margin of the external auditory meatus. The bulla in *Dasypus* and *Orycteropus* is not ossified, only an annular ring is present, whereas in *Zaëdyus* the bulla is ossified, but unlike *Pentapassalus* does not participate in the margin of the external auditory meatus as this is formed entirely by the mastoid and squamosal. Posterolateral to bulla the margin of the skull is formed by the well-inflated mastoids, unlike the armadillos but somewhat more as in *Orycteropus*. Posterior to the bulla the foramen lacerum posterius is evident, and the condylar or hypoglossal foramen is distinct and posterior to it. The stylomastoid foramen would be distinctly marginal in position, immediately posterior to the external auditory meatus. Its exact position and that of the hyoid articulation are somewhat indistinct in the fossil as a result of minor fracturing. The occipital condyles are not so widely separated as in armadillos and these do not so nearly encroach on the mastoids, or bullae.

Comparison of the skull of *Pentapassalus pearcei* with other fossil types shows a marked resemblance to various previously described palaeanodonts; however, important differences were noted which clearly distinguish the genus. The cranium of *P. pearcei* is almost as wide as in Gray Bull *Palaeanodon ignavus* Matthew (1918, figs. 39, 40) but shorter, and the total skull length is very much less. In keeping with the relatively shorter cranium the bullae are placed farther back than are the incompletely ossified bullae or annular rings in *P. ignavus*. The rostrum in *P. ignavus* is markedly elongate but not attenuated as in *Dasypus*. The dentition of *P. ignavus* is much farther forward than in *P. pearcei* and the number of teeth appears to have been less. In an occipital view the mastoid portion is rather similarly developed in the two fossil forms but in *P. ignavus* the lambdoidal crest does not appear to be carried on by the squamosal, above and lateral to the mastoid as in *Pentapassalus*.

The skull differences between *Pentapassalus* and *Metacheiromys* (see Simpson, 1931) are similar to those between *Pentapassalus* and *Palaeanodon*. However, the teeth in the Bridger genus are much further reduced and the bullae are more completely ossified than in *Palaeanodon*. The bullae in *Pentapassalus* resemble very much in form those in *Metacheiromys* but are much more posterior in position.

I find no certain evidence in *Pentapassalus* of an entotympanic, although a somewhat crushed zone around the posteromedial margin of the left bulla is inconclusive, and the right bulla has been thrust medially concealing this area. The glenoid surface for articulation of the lower jaw is transversely much wider and has a better-developed postglenoid process in *Metacheiromys.* The slope of the occiput is similar in the two forms and the lambdoidal crests appear to be similarly developed with respect to the mastoid exposure discussed above. However, the braincase is much more inflated in *Pentapassalus* and the skull is relatively shorter and broader posteriorly.

Comparisons with the Oligocene epoicotheriids show *Pentapassalus* to be more closely allied to the Epoicotheriidae than to the Metacheiromyidae, although known members of the latter family are more nearly contemporaneous. *P. pearcei* strongly resembles the skull form of the much smaller *Epoicotherium unicum* Douglass (1905, pl. 22, figs. 13-16; see also Simpson, 1927, pl. 24). Most noticeable differences, however, lie in the dorsoventral attenuation of the rostrum, the posterior elongation of the palate, the transversely much-constricted choanae, and the continuation of the pterygoid crest onto the bulla in *Epoicotherium.* The lambdoidal crest continues ventrally outside of the mastoid portion, somewhat as in *Pentapassalus,* but the occiput is much more inflated posteriorly in the Chadron form, strikingly as in *Chrysochloris,* as has been noted by others. The dental formula for the upper cheek-tooth series is the same in both fossil forms.

Xenocranium pileorivale Colbert (1942) from the still later Brule beds of Wyoming is distinguished by the remarkable expansion of the mastoid-squamosal region of the skull, much beyond that in either *Epoicotherium* or *Pentapassalus.* The bullae in this form occupy a posterior position but are transversely much elongated. *Xenocranium* has lost one more postcanine tooth, above and below, than has *Pentapassalus.*

Mandible.—The lower jaw of *Pentapassalus pearcei* is quite unlike that in recent armadillos and *Orycteropus.* It corresponds closest in size and form to that in *Metacheiromys marshi* Wortman (1903, pp. 347-352) or *Metacheiromys tatusia* Osborn (1904, p. 165; see also Simpson, 1931, p. 303). The jaw is of nearly uniform depth beneath the cheek teeth, deepening but slightly on the outside posteriorly. Anterior to the single incisor the jaw tapers abruptly, and a short distance posterior to the last molar the anterior margin of the ascending ramus rises rather sharply to about 90° from the line of the tooth row, beneath its posterior deflection near the crest of the coronoid process. The coronoid process is much like that in *Metacheiromys* and is separated by a broad U-shaped concavity from the condyle. The condyle is gently convex, anteroposteriorly, and wider than long. The angle is deflected markedly downward, below the inferior margin of the horizontal ramus, and is widely separated from the condyle, more so than in *Metacheiromys.* The masseteric fossa is a weak triangular depression on the outer surface, and the inferior dental foramen on the lingual side of the jaw has a markedly posterior position in comparison with recent armadillos. Externally, a mental foramen is exhibited beneath a point between the first and second postcanine teeth and somewhat lower between the second and third. The horizontal ramus reaches its thickest at the position of the canine, and again at about the posterior margin of the last molar. The width at the latter position is brought about by a shelflike ridge on the lingual side, which in *Pentapassalus* can scarcely be attributed to a pad as in monotremes, although this has been postulated for the more nearly toothless *Palaeanodon* and *Metacheiromys.*

Comparison of the lower jaw of *Pentapassalus pearcei* with that of *Tubulodon taylori* shows the latter to be less robust but with a little larger teeth and the anterior margin of the ascending ramus rises much more gently. The lower jaw of *Epoicotherium unicum* is not known, but that for *Xenocranium pileorivale* is relatively much more robust, though actually considerably smaller than *P. pearcei.*

Dentition.—The dentition of *Pentapassalus* can be more clearly recognized as the normal mammalian heterodont type than can members of the Metacheiromyidae or other Epoicotheriidae. The presence or absence of any upper incisors cannot be determined, but a single lower incisor, separated from the canine by a small diastema, is present. Strong upper and lower canines are preserved. These are deep-rooted and the crowns are triangular in section, and enamel-covered, except where worn through occlusion. The cheek-tooth series includes five postcanine teeth in the maxilla and six in the lower jaw. In upper series the first of these is close to the canine but separated by a short diastema from the second. These appear to be single-rooted premolars and are followed closely without diastema by three molars. The first and second molars appear from their outline at the alveolar margin to be three-rooted. The third upper molar is more nearly circular at the alveolus but exhibits vestigial roots at the base of the peg or stumplike crown.

There are three lower premolars, the first of which is very small, and apparently pointed. It follows the lower canine by a diastema which permits occlusion of the upper canine. The second and third of the lower premolars are isolated by short diastemata, the last being separated by a somewhat smaller space from the three uninterrupted molars. The roots of the last premolar and second molar were investigated and found to be single; whereas the first molar was found to have two roots, which can be detected even well above the alveolar margin. Presumably, M_3 and the anterior premolars are single-rooted.

The crowns of the cheek teeth are nearly flat with two planes of occlusion meeting at a widely obtuse angle in a low transverse ridge, generally near the middle of the tooth. The angle between these occlusal planes is nowhere nearly so acute as in living armadillos. In the premolar region these occlusal areas also slope more downward and outward than in the molar region. A band of enamel surrounds the crown or appears preserved on the lingual and labial margins, if wear has not progressed too far. Occlusion of each cheek tooth is, of course, with two in the opposite jaw, giving the crown a subdued gable appearance. This is unlike the type of occlusion described for *Xenocranium.*

The lower teeth in *Pentapassalus* are most like those in *Tubulodon taylori* Jepson (1932), but do not exhibit the cuspate development seen in the latter, probably a difference which may be attributed to wear. The most significant difference lies in the persistence of double roots in the last premolar and second molar as well as in the first molar of *Tubulodon.* A superficial similarity is seen in the microscopic tubular structure of the teeth of the two forms. This tooth condition in *Pentapassalus* may not be the same as that in *Tubulodon,* and is here apparently of no taxonomic importance, as it may be observed in bones and teeth of other, quite unrelated forms in this fauna.

Appendicular skeleton.—The limb and foot material of *Pentapassalus pearcei* is so completely like that in *Metacheiromys* that had not the skull and jaws been found the material would have been referred unhesitatingly to that genus. Of the various palaeanodonts, limb material has been described only of *Palaeanodon* and *Metacheiromys.* None so far has been recorded of the Oligocene forms. In almost every instance differences noted from the more nearly contemporaneous *Palaeanodon* have been in the direction of *Metacheiromys.* No special resemblance to *Orycteropus* limb material has been noted. In all elements the limb material of *Pentapassalus pearcei* is the same size or but a little larger than that in *Metacheiromys tatusia* Osborn, as described and figured by Simpson (1931).

Scapula.—The right scapula is preserved, but incompletely along the thin, prescapular border, and the acromion is missing. The exhibited portion of the spine is remarkably high and rugged with the crest turned posteriorly giving strength comparable to that of the postscapular border.

Fore limb.—Comparison of the humerus (fig. 3*a*) is made with that of *Metacheiromys dasypus* inasmuch as this bone in *M. tatusia* is not illustrated; nevertheless, correspondence in form is amazingly similar. Differences noted in the illustration of *P. pearcei* and that of *M. dasypus,* except for size, are due in part to orientation. The lesser tuberosity extends somewhat lower on outer side of the proximal end, and the width of the deltoid process distally appears slightly less, but is incomplete in *P. pearcei.* The supinator ridge and much of the distal extremity are almost identical in the two.

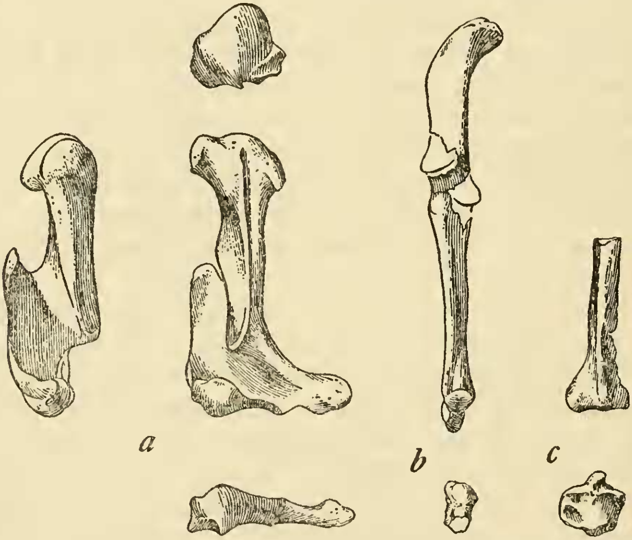

FIG. 3.—*Pentapassalus pearcei,* new genus and species: *a,* Right humerus, restored from left side, proximal, lateral, anterior, and distal views, natural size; *b,* right ulna, anterior and distal views, approximately nine-eighths natural size; *c,* distal portion of right radius, anterolateral and distal views, approximately five-fourths natural size. Type specimen (U.S.N.M. No. 20028). Upper Knight, lower Eocene, Wyoming.

Only the distal portions of the radii (fig. 3*c*) are preserved. These show an anterior crest which is well developed distally, but a short distance (about 7 mm.) from the distal end it is abruptly reduced, giving rise to a noticeable upward-directed process that is better developed in *Metacheiromys.* The distal articular surface shows no distinctive features in comparison with the *Metacheiromys* radius.

The shaft of the ulna (fig. 3*b*) may be somewhat less curved laterally in the anterior view than in *Metacheiromys dasypus* but the olecranon is almost identical in its relative proportions and the inward curvature of its extremity. The sigmoid notch is incomplete in *P. pearcei.*

Pelvis and sacrum.—Portions of right and left innominate bones, together with part of the sacrum are preserved. The right side is more nearly complete than the left, but both lack the pubic portion. The ilium is slender and outwardly curved, extending, as in *Metacheiromys,* well in advance of the sacrolumbar contact. Three elements are involved in the sacrum as indicated by the fused spines, probably about as in *Metacheiromys;* however, as shown in the referred specimen of *M. marshi,* there may have been a fourth centrum fused to this series. The anterior zygapophyses for articulation with the last lumbar are apparently much larger than in *M. tatusia.*

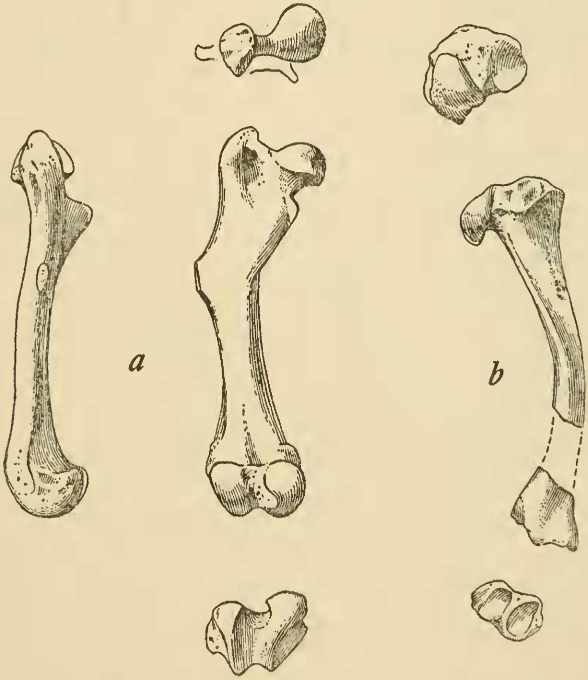

FIG. 4.—*Pentapassalus pearcei,* new genus and species: *a,* Left femur, proximal, lateral, posterior, and distal views, natural size; *b,* left tibia, proximal, posterior, and distal views, approximately five-fourths natural size. Type specimen (U.S.N.M. No. 20028), Upper Knight, lower Eocene, Wyoming.

Hind limb.—Both femora (fig. 4*a*) are included in the *P. pearcei* skeleton, and these so closely resemble the femur of *Metacheiromys* *tatusia* figured by Simpson that no significant differences can be detected. Comparison with *Palaeanodon* is fair, although Matthew's illustration of the femur in his figure 52 (1918), with his description of *P. ignavus,* does not particularly resemble that shown in figure 65B. In *Dasypus novemcinctus* the shaft is curved somewhat as in *P. pearcei* but the greater trochanter is far better developed and the relatively large third trochanter is more distally placed.

The details of the tibia (fig. 4*b*) are also decidedly like those of *M. tatusia.* It is noted, however, in *P. pearcei* that the external tuberosity of the proximal extremity extends a conspicuous process laterally and distally carrying the articular surface for the fibula. Also, the shaft may curve posteriorly somewhat more just beyond the lower limit of the cnemial crest.

Only the proximal extremity of the right fibula is included in the Knight material. This shows little of significance other than being transversely flattened and the articulation for the tibia is a surface almost at right angles to the longitudinal axis of the shaft.

Foot bones.—The foot material of *Pentapassalus pearcei* includes the lunar, magnum, trapezoid, second and third metacarpals, and various phalanges of the manus; but of the pes, only a part of the astragalus is preserved. The lunar would seem to be much like that described by Simpson for *Metacheiromys dasypus;* however, it differs from the illustration of this element in that the radial surface extends entirely to the distal surface at the dorsal margin, much as in *Dasypus novemcinctus.* The distal surface differs from that of the armadillo, as described by Simpson, in that the articulation for the magnum is sharply offset into two parts, the rectangular, more dorsal surface being distinctly more distal and separated from the concave, nearly circular, and more palmar surface by a sharp transverse ridge. A slender, dorsoventrally concave articular surface is seen for the unciform which widens somewhat palmad and distally. Dorsal to this, and more laterally facing, is a facet for the cuneiform.

The trapezoid, in proximal view, is a triangular bone with its acute apex directed palmad. The triangular surface for the scaphoid is dorsoventrally concave in its palmar portion and convex dorsally. A triangular surface is seen dorsally on the inner side for the trapezium, and a plane crescentic surface dorsally on the external side for the magnum. Distally, the trapezoid exhibits two dorsoventrally elongate depressions, with an intervening saddle, the outer of which is the longer, for articulation with the second metacarpal. The trapezoid apparently does not articulate with the third metacarpal, nor is this the case in *Dasypus novemcinctus.*

The proximal surface of the magnum shows, as indicated above, a rectangular shelf and raised, knoblike, more palmar portion for the lunar articulation. The dorsal surface of the magnum is irregular, much as in *Metacheiromys dasypus,* not so nearly rectangular as in *Dasypus novemcinctus.* On the dorsal part of the inner aspect a plane, pentagonal, somewhat proximal facing surface is seen for contact with the trapezoid, and the palmar portion of the inner aspect exhibits a rounded concave surface for a projection of the second metacarpal much as in *Metacheiromys.* The outer surface of the magnum exhibits an irregular concave surface for the unciform. The distal articular surface is a dorsoventrally, deeply concave saddle for the third metacarpal.

The second metacarpal is a very short and sturdy bone, about three-fourths as long as the third metacarpal. The proximal extremity is nearly rectangular, deeply grooved dorsoventrally in the more dorsal portion, and the inner-palmar angle is formed by a prominent rounded knob separated from the articular surface. The dorsal portion of the inner margin shows a small, inward-facing surface for articulation, presumably with the trapezium, and on the dorsal portion of outer margin the facet for the third metacarpal faces somewhat distally. The outer more palmar surface for the magnum is relatively smaller and is not oriented so distinctly proximal as in *Dasypus novemcinctus.* Distally, the surface for articulation with the first phalanx is much broader than the proximal extremity, and is dorsoventrally more constricted on its inner side than on the outer. Dorsally the surface is transversely cylindrical with prominent, symmetrically placed pockets, palmar to the convexity. The shaft of the second metacarpal is very broad dorsally, this aspect being much emphasized by the process for the extensor muscle, which is about midway on the outer margin.

The proximal extremity of the third metacarpal is much more convex, dorsoventrally, than the second. The dorsal portion is relatively broad and concave for articulation of the magnum. A short distance palmar to the dorsal portion the proximal extremity is noticeably constricted transversely, giving the proximal aspect a T-shaped appearance. The external knob of the dorsal expansion articulates with the second metacarpal, whereas the internal knob shows a narrow, limited surface for articulation with the unciform, very much less than in *D. novemcinctus,* but immediately distal to this more proximal surface is a relatively large, outward and palmad-facing concavity, faceted for articulation with the fourth metacarpal. The distal articular surface is for the most part transversely cylindrical with the palmar pockets more feebly developed than in the second metacarpal.

The shaft is sturdy and slightly arched dorsally. The process for the pars brevis of the extensor muscle is very prominent, proximal to the midpoint of the inner margin of the dorsal surface, but somewhat distal to the equivalent process on the second metacarpal. The latter condition is reverse to that seen in *Metacheiromys dasypus.*

The metacarpals and phalanges are not only smaller but relatively shorter than in *Palaeanodon ignavus.* They resemble materials from the Lost Cabin beds attributed by Matthew to *?Palaeanodon,* species, but are rather smaller. These Lost Cabin elements might, of course, represent *Pentapassalus* or *Tubulodon.*

The intermediate phalanges and claw cores are quite like those figured for *Metacheiromys,* except that there is a suggestion that the articulation on the claw may extend somewhat more dorsoventrally around the distal articular surface of the second phalanx than in the Bridger type and the claws may be more curved in a vertical plane.

The head of the astragalus, which is the only part of the hind foot preserved, shows a surface broadly curved transversely for the navicular, and a relatively large, slightly convex sustentacular facet close to that for the navicular. The details are much like those shown by Matthew for *Palaeanodon ignavus.* The body of the astragalus is missing.

Remarks.—Undoubtedly the most significant, and certainly the most interesting find of the several seasons' collecting in the Knight beds is this rare edentate mammal. During the earlier stages of this investigation a rather striking tubular structure noted in the teeth was thought to ally it peculiarly with *Tubulodon* from the Wind River beds, and to place it in some position of relationship to *Orycteropus.* Further observations, however, have shown that so far as the Knight materials are concerned that is not the case. The microscopic, irregular, anastomosing clusters of tubules, quite independent of the Haversian system, were also noted in otherwise dense and somewhat translucent bone and teeth of certain other forms in the fauna, cautioning against regarding the structure as significant in teeth of *Pentapassalus.* The structure noted in the above material was surely of post-mortem development.

Pentapassalus shows very little of importance in the skull structure that would tend to ally it to the Tubulidentata, no more than edentates in general might resemble them. In its general skull form and in retention of the teeth it is most closely allied to the Oligocene *Epoicotherium* of the various palaeanodonts, and is placed in Epoicotheriidae rather than with the longer-skulled, more nearly edentulous and more nearly contemporaneous metacheiromyids. Limb and foot structures are similar to those in *Metacheiromys* but it is very likely that *Epoicotherium* was similarly adapted.

MEASUREMENTS OF TYPE SKELETON OF

Pentapassalus pearcei, NEW GENUS AND NEW SPECIES, U.S.N.M. NO. 20028

	mm.
Skull:	
Length, anterior extremity of nasals to condyles	*a* 59.0
Width at postorbital constriction	*a* 18.0
Length of cranium from postorbital constriction to lambdoidal crest	23.5
Width of cranium across squamosal portions of lambdoidal crests	34.7
Depth of occiput from top of crest to bottom of condyles	19.2
Mandible:	
Length of mandible from anterior extremity to condyle	42.5
Depth of jaw beneath M_1 internally	5.2
Thickness of jaw at widest part immediately behind M_3	4.0
Dentition:	
C to M^3, incl.	15.7
I to M_3, "	21.3
C to M_3, "	18.5
M^1 to M^3, "	8.5
M_1 to M_3, "	6.9
Anteroposterior diameter of last upper premolar	2.0
Anteroposterior diameter of M^2	3.0
Transverse diameter of M^2	2.5
Anteroposterior diameter of last lower premolar	2.2
Transverse diameter of last lower premolar	1.6
Anteroposterior diameter of M_2	2.4
Transverse diameter of M_2	1.9
Fore limb:	
Length of humerus, head to articular surface for ulna	37.0
Transverse width of humerus across proximal tuberosities	12.1
Greatest transverse width of humerus across condyles of distal extremity	21.7
Depth of distal extremity of humerus across capitulum for ulna	5.5
Length of deltoid crest from greater tuberosity	28.0
Length of supinator ridge from surface for ulna	22.0
Width of distal extremity of radius	7.0
Depth of distal extremity of radius incl. longitudinal ridge	7.5
Greatest length of ulna	48.7
Length of olecranon from sigmoid notch	*a* 18.5
Greatest width of distal extremity of ulna	6.0
Length of second metacarpal	7.1
Width of proximal extremity of second metacarpal	3.5
Width of distal extremity of second metacarpal	5.0
Length of third metacarpal	9.5
Width of proximal extremity of third metacarpal	5.5
Width of distal extremity of third metacarpal	5.3

a, Approximate.

Hind limb:	mm.
Greatest length of femur	50.0
Width of proximal extremity of femur across head and greater trochanter	15.0
Width across condyles of distal extremity of femur	13.5
Depth of distal extremity of femur	10.5
Width of proximal extremity of tibia	12.4
Depth of proximal extremity of tibia	10.0
Width of distal extremity of tibia	9.4
Depth of distal extremity of tibia	5.6
Width of proximal extremity of fibula	3.2
Depth of proximal extremity of fibula	6.6

RODENTIA

ISCHYROMYIDAE

PARAMYS, cf. COPEI [13] Loomis

Seven isolated lower-jaw portions and an isolated upper molar, in addition to a specimen, U.S.N.M. No. 19306, including both rami of the mandible with some associated limb and vertebral fragments, represent in the La Barge fauna a moderate-sized paramyine rodent, tentatively referred to the species *Paramys copei* Loomis (1907a, p. 128).

Examination of the teeth of the upper Knight paramyine jaws in comparison with various specimens of Bridger *Paramys* shows little or no significant structural differences upon which, on teeth alone, one could reasonably separate these upper Wasatchian forms generically from true *Paramys*. The lack of definitive characters in the teeth was noted by Matthew (1920) in his description of *Reithroparamys*. *Paramys* appears to be a highly diversified genus, with Wasatchian species assigned to it more than covering the possible size ranges. Moreover, minor differences in teeth attributed to some of these species are probably, in view of Bridger variations, of no systematic significance, so that several of the species are likely invalid. Final allocation of the Knight species herein discussed awaits revision of the paramyids currently under study by A. E. Wood.

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[13] While this paper was in press, Dr. A. E. Wood, who is revising the paramyids, examined these specimens and informs me that most of them surely represent *Paramys copei*, but that U.S.N.M. Nos. 19305 and 19306 should be referred to *Paramys major*, and a third, No. 19307, may be a new species.

PARAMYS, cf. BUCCATUS[14] (Cope)

An immature lower jaw, U.S.N.M. No. 19302, with the molar teeth broken off, but with the last premolar erupting, is compared, on the basis of the size of P_4, to Cope's (1877, p. 171) species, *Paramys buccatus.* There are also in the upper Knight collection fragments of a skull, including a single upper molar which cannot be distinguished from the type of this New Mexican species. Although Loomis (1907a, p. 130) considered this species as possibly belonging to *Sciuravus,* as Matthew (1910, p. 51) has noted, it is clearly paramyine and not sciuravine.

A left ramus of a mandible with portions of P_4 to M_2, inclusive, No. 12845 of the Knight collection of the American Museum, is very close in size of P_4 to U.S.N.M. No. 19302, and may also represent *Paramys buccatus.* This was included among the materials collected by Granger and Miller in 1906 from the bluffs along Bear River near Knight station.

SCIURAVUS, possibly S. DEPRESSUS Loomis

Recognition of *Sciuravus* in the lower Eocene has in the past been attended by serious doubt. In 1907 (a, p. 130) Loomis described three upper molars and a lower molar as the species *Sciuravus depressus,* from a locality in the Wind River beds near Lost Cabin, Wyo. Matthew, though cognizant of the occurrence in 1910, as shown by his phylogenetic chart and distribution table, did not comment on it, and in 1918 (p. 619) ignored the possibility, and listed *Sciuravus* without comment only in the middle and upper Eocene. Troxell in 1923 (a, p. 385) dismissed the possibility with the comment that from the drawings he judged the form to be not *Sciuravus* but a separate genus. Wilson (1938, p. 129) in his revision of *Sciuravus* based on the Bridger rodents in the Marsh collection cited the occurrence but added Troxell's comment. Again in 1949 (p. 79) Wilson cited *"Sciuravus depressus"* in the Lysite fauna, with the reservation that although this species apparently could not be referred to the genus *Sciuravus* it might be tentatively included in the Sciuravinae. No critical examination of the specimen has been reported since Loomis described it, and Loomis's illustration is clearly unsatisfactory, so that in reality the presence of *Sciuravus* in the lower Eocene has not been entirely discredited.

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[14] Dr. A. E. Wood has since examined these specimens and indicates that this small Wyoming *Paramys* should be referred to *Paramys excavatus* Loomis rather than the New Mexican *P. buccatus.*

Sciuravus material in the upper Knight collection consists of the left ramus of the mandible, U.S.N.M. No. 19309, with P_4 and M_1, from about 12 miles north of Big Piney, Wyo. The species represented in the La Barge fauna is intermediate in size between *Sciuravus nitidus* Marsh and *Sciuravus bridgeri* Wilson of the Bridger fauna. It appears to be close in size to *Sciuravus depressus,* judging by Loomis's figure of 8 mm. for the lower molariform series.

TILLOMYS SENIOR,[15] new species

Text figure 5

Type.—Right ramus of mandible with P_4 to M_2, inclusive, U.S. N.M. No. 19308.

Horizon and locality.—Upper Knight beds, La Barge fauna, SW¼ sec. 33, T. 32 N., R. 111 W., 12 miles north of Big Piney, Sublette County, Wyo.

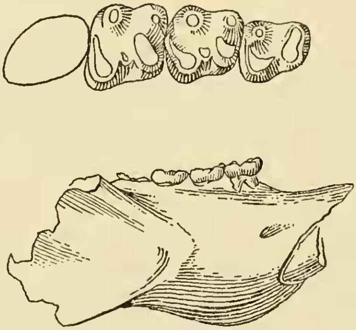

Fig. 5.—*Tillomys senior,* new species: Right ramus of mandible (U.S.N.M. No. 19308), type specimen; occlusal view, × 6; lateral view, × 3. Upper Knight, lower Eocene, Wyoming.

Specific characters.—Size much smaller than *Tillomys senex* Marsh (1872, p. 219) and appreciably smaller than *Tillomys parvidens* (Marsh) (1872, p. 220). Teeth with cusps very low and crests subdued, increasing in size from P_4 to M_2. Tooth row shorter than in *T. parvidens,* but jaw relatively deeper. Masseteric fossa does not extend so far forward with respect to teeth as in *T. parvidens.*

Description.—The above type is the only known specimen but is in a rather good state of preservation. The crowns of the first three cheek teeth are intact though worn to the point of exposing dentine in the central portion of each cusp. The occlusal portion of the incisor and the crown of M_3 are broken off.

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[15] Older, comparative of *senex;* forerunner of *Tillomys senex.*

The details of the cusp arrangement in *Tillomys senior* are so like those in *T. parvidens* that confusion with other known genera of Eocene rodents seems entirely improbable. The cusps are even more subdued, possibly in part due to wear, than in the Bridger material examined, particularly the metaconid, and the cusps are perhaps more conical with less tendency toward development of crests. The entoconid is isolated with a very weak, posteroexternally directed crest, distinct from the internally directed posterolophid. The mesoconid is a simple conical cusp wedged between the protoconid and hypoconid. The pattern of wear on the protoconid suggests two low spurs directed toward the metaconid. Each of the three preserved teeth shows the trigonid to be narrower than the talonid and each succeeding tooth is wider than that preceding. M_3, though broken off, is clearly longer than M_2, but the width cannot be ascertained.

The teeth in *Tillomys senior* are only slightly larger than in the type of *Mysops kalicola* from the Lost Cabin beds, but the pattern of the crown is essentially different. *M. kalicola* in addition to having highly rugose enamel in the more deeply basined crown has sharper, more arcuate cusps and the crests or lophs are developed more continuously across the crown. Moreover, the jaw of *M. kalicola,* while deeper beneath M_3, becomes shallower forward beneath the anterior cheek teeth, and is transversely more slender.

MEASUREMENTS OF TYPE LOWER JAW OF
Tillomys senior, NEW SPECIES, U.S.N.M. NO. 19308

	mm.
Length of cheek-tooth series	*a* 6.6
Length of P_4 to M_2, incl.	4.6
P_4, anteroposterior diameter: greatest transverse width	1.5 : 1.3
M_1, “ “ “ “ “	1.5 : 1.5
M_2, “ “ “ “ “	1.6 : 1.7
Depth of jaw beneath M_1, on inner side	5.9

a, Approximate.

Remarks.—The occurrence of *Tillomys senior* in the Knight fauna of the Green River basin extends the known geologic distribution of *Tillomys* into the lower Eocene. The principal significance of this fact is the additional evidence afforded of the remarkable conservatism of rodent genera in Eocene time, adding to that of *Paramys* and *Sciuravus.* This is in striking contrast to the still more remarkable evolutionary change which took place in certain other groups of mammals between Lost Cabin and Bridger time. All of which is further proof of the antiquity of the order Rodentia, and arouses speculation as to why so little rodent material is known from the Paleocene, and where their earlier center of dispersal might have been.

CARNIVORA

ARCTOCYONIDAE

THRYPTACODON, near T. ANTIQUUS Matthew

Although Matthew (1915a, p. 7) stated that *Thryptacodon* has not been found in the Lysite or Lost Cabin, Van Houten (1945, p. 452) noted the presence in American Museum collections of a specimen of *T. antiquus* labeled "?Lysite" from the Big Horn basin. The upper Knight materials, which consist of a right upper molar and a tentatively included maxillary fragment with two milk teeth, appear to extend the range to Lost Cabin time.

The isolated upper molar, U.S.N.M. No. 19476, corresponds closely to *Thryptacodon antiquus* material of Gray Bull age in the National Museum collections and is almost identical in size and pattern to the second molar in the type specimen figured by Matthew (1915a, fig. 4). The maxillary portion, U.S.N.M. No. 19343, with the two teeth believed to be deciduous third and fourth premolars, rather resemble P^4 and M^1 of *Thryptacodon,* but are noticeably elongate anteroposteriorly, particularly the labial portion. The appearance and proportions of these teeth are about as one might anticipate in a *Thryptacodon* milk dentition.

MESONYCHIDAE

PACHYAENA? species

Two specimens, a single lower tooth and one associated with bone fragments, would appear to represent *Pachyaena* in the New Fork fauna. The development of the paraconid on these suggests P_4 and M_1. They are rather close in size to these teeth in *Pachyaena gracilis.*

OXYAENIDAE

OXYAENA, species

A single lower molar, obtained by Princeton University in association with the *Ambloctonus* jaw described below, and carrying the number P.U. 16176, was among the Knight materials which Dr. Jepsen has permitted me to include with my study of the Smithsonian collections. This tooth is readily recognized as a first lower molar of *Oxyaena;* however, the species represented is not evident. In size it corresponds very closely to the New Mexican *Oxyaena lupina* Cope. Resemblance on the basis of such limited material, however, scarcely justifies extending the range of this species to the late lower Eocene of Wyoming.

AMBLOCTONUS, cf. MAJOR Denison

Plate 6, figure 2

An *Ambloctonus* lower jaw, obtained by Princeton University from a locality in the upper Knight about 2 miles southeast of La Barge, Wyo., was kindly loaned to me for study by Dr. G. L. Jepsen. This specimen, P.U. No. 14720, includes P_2 to P_4, inclusive, and M_2, and exhibits alveoli for the canine and M_1.

The premolars of the Princeton specimen are a little like those in *Oxyaena forcipata,* but, as in *Ambloctonus,* are distinctly broader, particularly across the talonid, perhaps blunter, and P_4 exhibits a better-developed parastylid. These teeth are relatively longer and apparently less hypsodont than in *Palaeonictis.* M_1 was remarkably large, as indicated by the alveoli, the posterior of which is considerably longer, anteroposteriorly, than the anterior. M_2 is of reduced size, with a much curved shearing blade, no metaconid, and a very small talonid. The narrowness of the talonid and absence of a metaconid on this tooth are characteristic of *Ambloctonus,* and distinguish this form from *Palaeonictis.*

The type of *Ambloctonus major* Denison (1938, p. 176), as figured by Matthew (1915a, fig. 53) under reference to *Ambloctonus hyaenoides,* consists of a fragmentary jaw with M_1 and part of P_4. Direct comparison in not feasible, but the size of the preserved molar in the Lost Cabin type specimen corresponds almost exactly to the space for the missing tooth in the upper Knight jaw.

Among fragments of carnivore teeth found in the New Fork beds is a left P_3 which resembles closely this tooth in the Princeton jaw from near La Barge. It is about the same length but slightly wider. It lacks a paraconid as in both *Ambloctonus* and *Palaeonictis* but its profile in lateral view is much more like *Ambloctonus.*

LIMNOCYONIDAE

PROLIMNOCYON ELISABETHAE,[16] new species

Plate 5, figures 1-3

Type.—Both rami of the mandible with the canine and P_2 to M_2, inclusive, represented, U.S.N.M. No. 19350.

Horizon and locality.—Upper Knight beds, La Barge fauna, north side of "Red Hill," western margin of SW¼ sec. 23, T. 29 N., R. 111 W., about 5 miles southeast of Big Piney, Sublette County, Wyo.

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[16] Named for my wife, who found the type specimen.

Description.—Teeth a little smaller and much more slender than in *Prolimnocyon antiquus.* P_2 to P_4 with increasingly prominent parastyle. Talonid of molars narrower than in *P. antiquus* and lower jaw a little shorter, shallower, and much more slender. M_3 single-rooted.

Discussion.—In addition to the pair of jaws described above as the type of this species, there are portions of right and left maxillae of one individual, U.S.N.M. No. 19348, including P^4 to M^2 between them, and a third individual, U.S.N.M. No. 19349, represented by a left mandibular ramus with portions of P_4 and M_1.

The type of *Prolimnocyon antiquus* from the Lost Cabin beds consists of right jaw portion with only the heel of M_2 preserved. An isolated M_1 from the opposite side is included with the type and may have been used by Matthew (1915a, fig. 63) to illustrate this tooth in the jaw. The M_1 referred to the type is fairly robust and has a decidedly broad, basined talonid, wider than in M_2 and relatively much larger than in the type of the earlier *Prolimnocyon atavus.* M_1 in the type of *Prolimnocyon elisabethae* is smaller, much more slender and has a considerably smaller talonid than that attributed to *P. antiquus.* The premolars in *P. elisabethae* are almost as long as in *P. antiquus* but more slender as indicated by root portions in the type of the latter. A referred specimen of *P. antiquus,* A.M. No. 2971, shows P_3 and P_4 to have almost no parastyle, and the parastyle is weak or absent in material of Gray Bull *P. atavus.* In *P. elisabethae* the parastyle is weak on P_2 but decidedly prominent on P_4.

Right and left maxillae, U.S.N.M. No. 19348, have between them P^4 to M^2, inclusive. A single small alveolus is preserved of M^3 but the specimen is incomplete lingual to this point so that the presence of additional alveoli for this much-reduced tooth cannot be determined. P^4 shows a single large primary cusp and a sharp high-cusped deuterocone, the latter of which is separated by a deeply indented anterior border from the distinct parastyle. The tritocone is somewhat elongate and approaches the crested form characterizing the first molar. In M^1 the paracone and matacone are distinctly more separated than in *Prolimnocyon atavus* of the Gray Bull stage, and the isthmus to the protocone is a little more constricted, with a better-developed and nearly continuous cingulum around the protocone. Also, the parastyle consists of a complex of two small stylar cusps together with a third small cusp between these and the paracone. M^2 is, of course, transverse with a greatly elongate parastyle, no metastyle, and a vestigial metacone. The striking difference between this tooth in *Prolimnocyon* and that in *Sinopa* is one of function, and Butler (1941) has shown in a study of *Hemicentetes* something of the mechanism or explanation of the transition that may account for the ways and means of divergence between these two creodonts. However, such a separation obviously took place at a much earlier and unspecialized stage of dental development in both lines, and by lower Eocene time this divergence has a basic, nonadaptive significance.

The numerous characters that have been used (Denison, 1938, pp. 241-242) to support transfer of the Limnocyoninae to the Hyaenodontidae are for the most part matters of degree in distinction from the Oxyaeninae, and largely of adaptive significance in comparison with Proviverrinae. Demonstration of a probable common ancestry does not necessarily justify inclusion of two groups of genera in the same family, particularly when these related groups diverge and develop their own taxonomic complex, such as horses and tapirs. Certainly the genera most typical of the family Hyaenodontidae, those included in the Hyaenodontinae, are strikingly distinctive and unlike *Limnocyon* and its allies. All things considered I find inclusion of the Limnocyoninae and Machairoidinae in the Hyaenodontidae untenable. On the other hand, the probable origin of *Prolimnocyon,* or rather of its ancestry, would suggest, although this is uncertain, a polyphyletic Oxyaenidae were the Limmnocyoninae to be retained in that family.

HYAENODONTIDAE

SINOPA VULPECULA Matthew

U.S.N.M. No. 19347, which consists of maxillae and jaws together with fragments of other skeletal portions, is regarded as representing in the La Barge fauna the small Lost Cabin species, *Sinopa vulpecula* Matthew (1915a, pp. 80-82). The teeth are close in size to those in the type but the jaw is slightly shorter, shallower, and straighter, also the coronoid portion not so high. P_1 is absent in both rami, but a slightly rugose depression well ahead of P_2 suggests an earlier presence, but loss before death. Though the animal was evidently not an aged adult, the third molar in both rami was broken to root stubs which were well worn before death. Also, the first molar is missing on the right side and the anterior alveolus for this tooth was completely closed before death.

The upper teeth are undamaged, so far as represented, and in the right maxilla P^2 to M^3 are present. Wear in the molar series was evidently restricted for the most part to occlusion with M_2 and the posterior root of M_3, although earlier occlusion with the trigonid of M_3 is indicated. However, wear resulting from M_1 is very slight, indicating a very early loss of this tooth. The upper molars of No. 19347 are much larger than those in the Lysite specimen figured by Matthew as possibly representing *Sinopa vulpecula.* They are close in size to those of the type of *Sinopa multicuspis* from the Eocene of New Mexico. The most noticeable difference from the latter is a greater lingual extension of the protocone portion in the molars and possibly less development of the parastyle on M^2 of the upper Knight specimen. The slenderness and lingual projection of the protoconal portion is rather noticeable in comparison with middle Eocene forms, such as *Sinopa rapax.*

It is also noted that the upper Knight form may compare favorably in size with *Tritemnodon? whitiae* Cope, but the lower premolars are more robust and longer in the latter, and the talonids of the lower molars are smaller. Upper teeth of a referred specimen of *T.? whitiae,* A.M. No. 4781, show no metacone on M^3 which is present in the Knight material, and P^3 shows a small talon not seen in the Knight specimen referred to *Sinopa vulpecula.*

SINOPA, cf. STRENUA (Cope)

A single left maxillary portion with the last two molars, U.S.N.M. No. 19345, tentatively referred to *Sinopa strenua,* shows the presence of a larger species of *Sinopa* in the La Barge fauna than is represented by the better-preserved material described above as belonging to *Sinopa vulpecula.* Direct comparison with the type of *S. strenua* is not feasible, inasmuch as the New Mexican specimen includes only the lower jaws; however, Matthew (1915a, pp. 74-75) has suggested the possibility of this species being represented by various Lost Cabin specimens. On the basis of size alone No. 19345 might come within the range of *S. strenua.*

MIACIDAE

DIDYMICTIS ALTIDENS Cope

Matthew's (1915a, pp. 19-26) revision of the lower Eocene species of *Didymictis* is an oversimplification of the situation, and includes errors which have led to confusion in attempts to identify Wasatchian materials representing this genus. It seems unlikely that he examined the type of *Didymictis protenus,* as the actual measurements of it are less than the range which he has given for the subspecies of this name. For the record these are P_1-M_2, inclusive, 53 mm.; and M_1-M_2, 18.3 mm. The ranges given for *Didymictis protenus lysitensis* and *Didymictis altidens* would appear to be diagnostic for the Lysite and

Lost Cabin horizons, whereas this is not the case. Several specimens of Lost Cabin *Didymictis* in the National Museum collections are within the range given for *D. p. lysitensis.* This is also true of the upper Knight materials, of which there are some 14 specimens from the vicinity of La Barge and Big Piney, Wyo. I do not believe, however, that a Lysite age is indicated thereby. It seems more probable, as Simpson (1937, p. 15) has suggested, that *Didymictis protenus lysitensis* is either a synonym of *D. altidens,* or a subspecies of the latter rather than of *D. protenus.* On this basis I have referred the upper Knight materials to *D. altidens.* They are scarcely comparable to the type *D. protenus* and only a little smaller than dimensions given by Cope (1880a, p. 746) for *D. altidens.*

Much of the *Didymictis* material in National Museum collections from the Gray Bull exhibits somewhat smaller proportions than *D. protenus,* and should any prove to represent a distinct species, the name *Didymictis leptomylus,* as well as the larger *D. curtidens,* is available. Simpson has shown that *D. leptomylus* possesses a remarkably small M_1; however, he regards the locality for the type as in doubt. This was clarified by Wortman, as reported by Matthew (1915b, p. 314), subsequent to Matthew's work on the Wasatchian carnivores. Hence, *Didymictis leptomylus* Cope, *Haplomylus speirianus* (Cope), and *Esthonyx spatularius* Cope, originally regarded as from Wind River beds, are shown to be Gray Bull, and almost surely lower Gray Bull. This is in accord with locality corrections later made by Cope without explanation.

VIVERRAVUS LUTOSUS,[17] new species

Text figure 6

Type.—Right ramus of mandible with P_2 to M_1, inclusive, U.S. N.M. No. 19339.

Horizon and locality.—Upper Knight beds, La Barge fauna, SW¼ sec. 33, T. 32 N., R. 111 W., 12 miles north of Big Piney, Sublette County, Wyo.

Description.—Size of teeth intermediate between Lost Cabin *Viverravus dawkinsianus* (Cope) and lower Gray Bull *Viverravus acutus* Matthew, but depth of jaw shallow as in *V. acutus.* P_1 two-rooted, P_3 with posterior accessory cusp, but less well developed than in P_4. Talonid of M_1 with trenchant, external hypoconid, and lingual portion distinctly basined.

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[17] From Latin *lutosus,* muddy, with reference to Muddy Creek where the type was found.

Remarks.—*Viverravus lutosus* material includes approximately eight specimens, all lower-jaw portions except for an isolated P^4. Most of these come from a badland locality on Muddy Creek about 12 miles north of Big Piney. The species is probably closest to *Viverravus dawkinsianus,* particularly in the development of the anterior premolars. However, it has distinctly smaller teeth, particularly P_4, and the lower jaw, though fully mature, is as shallow as in *Viverravus acutus.* The shallowness is most noticeable posteriorly beneath the molars, with the greatest depth beneath P_4. In other Wasatchian species the depth apparently increases posteriorly beneath the molars.

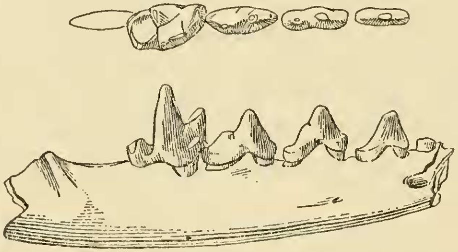

FIG. 6.—*Viverravus lutosus,* new species: Right ramus of mandible (U.S.N.M. No. 19339), type specimen; occlusal and lateral view, × 2. Upper Knight, lower Eocene, Wyoming.

MEASUREMENTS OF TYPE LOWER JAW OF

Viverravus lutosus, NEW SPECIES, U.S.N.M. NO. 19339

	mm.
Length of cheek-tooth series at alveoli, P_1-M_2, incl.	23.7
Length of premolar series, P_1-P_4, incl.	15.4
Length of molar series, M_1-M_2, incl.	8.7
Length of P_4 : width of P_4	4.9 : 1.8
Length of M_1 : width of M_1	5.1 : 2.9
Depth of jaw beneath P_4	5.4
Depth of jaw beneath M_2	5.3

UINTACYON ASODES,[18] new species

Plate 6, figure 1

Type.—Left ramus of the mandible with the canine, P_4, and M_1 preserved, U.S.N.M. No. 19351.

Horizon and locality.—Upper Knight beds, La Barge fauna, SW¼ sec. 33, T. 32 N., R. 111 W., 12 miles north of Big Piney, Sublette County, Wyo.

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[18] From Greek ἀσώδης, muddy, etc., with reference to Muddy Creek where the type was found.

Description.—Size near that of *Uintacyon massetericus* (Cope), but jaw a little deeper, and teeth wider and more robust. Premolars uninterrupted, except for very small diastemata before and after P_1. P_4 without paraconid. M_2 about 40 percent longer as measured at roots. M_3 single-rooted.

Remarks.—*Uintacyon asodes* is represented by a single specimen which consists of a lower jaw in which are preserved only the canine, last premolar, and first molar. The anterior premolars and posterior molars are indicated by root portions or alveoli. P_1 and M_3 are single-rooted. Comparison of *Uintacyon asodes* with the referred specimen of *Uintacyon massetericus,* which Matthew figured (1915a, fig. 24) instead of the type, shows the carnassial to be wider and the premolars to be less reduced and in closer sequence. Also, the lower jaw is shorter and deeper and would appear to have a straighter inferior margin or profile; however, the anterior part of the specimen Matthew figured is damaged and the restoration may not be correct.

Uintacyon is rare in lower Eocene deposits and this is apparently the first record of its occurrence in beds of Lost Cabin age. Representation in later Wasatchian was to be expected, however, inasmuch as the typical and better-known species are Bridger middle Eocene in age. *Uintacyon asodes* shows a definite trend toward the latter forms.

MEASUREMENTS OF TYPE LOWER JAW OF
Uintacyon asodes, NEW SPECIES, U.S.N.M. NO. 19351

	mm.
Length of dentition from P_1 to M_3, incl., at alveoli	*a* 35.0
Length of premolar series, P_1 (alveolus) to P_4	18.1
Length of molar series, M_1 to M_3 (alveolus)	*a* 17.0
Length of P_4 : width of P_4	6.1 : 3.3
Length of M_1 : width of M_1 at trigonid	7.5 : 5.5
Length of M_2 at roots	5.9
Depth of jaw beneath P_3, lingual side	13.0
Depth of jaw beneath talonid of M_1, lingual side	12.2

a, Approximate.

MIACIS, cf. LATIDENS Matthew

Lower jaw portions of three individuals, all from 12 miles north of Big Piney, exhibit teeth which are more like those in *Miacis* than any of the other miacids. One of these specimens, U.S.N.M. No. 19335, includes portions of both rami and has preserved all the cheek teeth, except P_1, on the left side. The measurements of these are almost the same as those given by Matthew (1915a, p. 34) for the type of *Miacis latidens.* Unfortunately, however, the type exhibits only the last two molars, so that only limited comparisons can be made. The upper Knight jaw has about the same depth beneath P_1 or P_2, but is much deeper beneath the molars, particularly M_3. M_2 corresponds in detail to that in the type and is about the same size; however, M_3 would appear to be slightly more like M_2 in outline than this tooth does in the type.

In addition to the few comparisons permitted with the type, it is further noted in the upper Knight specimen that P_1 and P_2 are isolated by diastemata, but that P_3 to M_3 are in a closed sequence. Of the premolars, only P_4 exhibits an accessory posterior cuspule. The trigonid of M_1 is high but those of the following molars are much reduced. The talonid in each of the molars is basined, though it appears somewhat more trenchant, particularly M_2, than in *Vulpavus australis,* and each tapers somewhat more posteriorly than in the latter. Moreover, M_3 appears more reduced than in *Vulpavus,* and although the crown seems to be a reduced image of M_2, the root portions are not so well separated. In U.S.N.M. No. 19334 the alveolus appears to be a single bilobed opening. The distinctions between species of *Miacis* and *Vulpavus,* though better defined in the middle Eocene, are less clearly discernible in lower Eocene materials, and some of the more fragmentary specimens, including isolated teeth, in the Knight collection could not be assigned with any certainty.

VULPAVUS ASIUS,[19] new species

Plate 5, figure 4

Type.—Portions of both rami of the mandible with P_3 and M_1-M_2, U.S.N.M. No. 19337.

Horizon and locality.—Upper Knight beds, La Barge fauna, SW$\frac{1}{4}$ sec. 33, T. 32 N., R. 111 W., 12 miles north of Big Piney, Sublette County, Wyo.

Description.—Depth of jaw about as in contemporary *Vulpavus canavus* Cope but teeth closer in size to those of *Vulpavus australis* Matthew of the New Mexican San Jose beds. The first two molars are of about the length of those in *V. australis* but relatively wider, and P_4 and M_1, as indicated by root portions, are longer. The trigonid of M_1 is higher, although relatively not so high as in *Miacis,* and the paraconid and metaconid are less widely separated giving the "V" of the trigonid a more acute angle at the protoconid.

Discussion.—*Vulpavus asius* may be represented by some half dozen specimens encountered at various localities in the upper Knight

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[19] From Greek ἄσιος, slimy, muddy; with reference to Muddy Creek where the type specimen was found.

beds. These appear to represent a form having a jaw about as robust as *Vulpavus canavus,* but with teeth significantly smaller. In this respect *V. asius* approaches Bridger material in the National Museum referred to *V. palustris,* although M_2 is distinctly shorter. The depth of the jaw, however, becomes a little shallower beneath the anterior premolars and, as shown in No. 19336 as well as the type, the symphyseal portion is not so deep as in *V. canavus.*

CONDYLARTHRA

HYOPSODONTIDAE[20]

HYOPSODUS WORTMANI Osborn

There are in the upper Knight collection over 100 specimens belonging to species of *Hyopsodus.* Of these, 29 can be clearly determined as belonging to *Hyopsodus wortmani.* Osborn (1902, p. 185) gave the length of the lower molar series as varying from 11 to 13 mm., whereas Matthew (1915b, p. 317) in his key to *Hyopsodus* cited 10 mm. Probably neither are correct as Osborn likely included some material which Matthew would have placed in *Hyopsodus mentalis lysitensis* and Matthew may have derived the figure of 10 mm. as characterizing the lower molar series from Osborn's dimension for the length of the upper molar series. In the few upper Knight specimens in which all the lower molars are preserved the range is from 10.5 to 11.5 mm. An upper molar series measures 10 mm.

The teeth in the upper Knight materials regarded as representing *H. wortmani* are markedly progressive; exhibiting well-developed hypocones in the upper molars, the trigonid of the lower molars has lost the paraconid, and the metaconid and talonid of P_4 are in an advanced stage of development. The advance is noticeable over Gray

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[20] The use of the family name Hyopsodontidae appears to have become established through usage, but largely as a result of a series of errors. Hyopsodidae was first used by Schlosser in 1887, but in 1889 Lydekker used Hyopsodontidae, attributing it to Schlosser with the comment "wrongly given as Hyopsodidae." Osborn in 1902 used Hyopsodontidae, also attributing it to Schlosser, and was followed by Weber, and others; however, Hay (Bibliography) in 1902 and Palmer (Index Generum Mammalium) in 1904 correctly credited Hyopsodidae to Schlosser (1887) and Hyopsodontidae to Lydekker (1889), and the earlier spelling was used by Wortman in his revision of the primates in 1903 and by Loomis, with the correct source cited in his revision of *Hyopsodus* in 1905. This was ignored by Matthew who reverted to Osborn in his revision of 1915. In 1930 Hay used Hyopsodontidae but probably because he erroneously gave the date of Lydekker's spelling as 1887. Simpson, in his classification of 1945, used Hyopsodontidae, but without reference to the earlier spelling.

Bull materials, and in particular when comparison is made with the more nearly equivalent-sized *H. simplex*.

In the New Fork materials is a fragmentary right mandibular ramus with M_3. The tooth corresponds well with equivalent material of *H. wortmani* from the upper Knight beds.

HYOPSODUS MENTALIS (Cope)

The much larger series of specimens of *Hyopsodus* in the La Barge–Big Piney collection are referred to the species *Hyopsodus mentalis*. These include materials covering a rather noticeable range in size, but within which no separation seems practical, or can logically be maintained. The dimensions given by Cope (1875, p. 17) for *Hyopsodus mentalis* fall well within the upper limits of this material, but it seems unlikely that the same species of this small mammal would be represented in so widely separated localities. However, on the basis of known material, the upper Knight form, represented by some 76 individuals, appears indistinguishable from the New Mexican species. Moreover, the range of the length of the lower molar series is about 13 to 14.5 mm. This would appear to average less than the range 14 to 15 given by Matthew (1915b, p. 320) for the Lost Cabin and New Mexican materials he included in the New Mexican species, and to overlap the inferred range of his *Hyopsodus mentalis lysitensis* which occurs in Lost Cabin as well as Lysite beds. Matthew's figures here should probably not be relied on as there are differences in cited measurements between key and text for some of the lower Eocene species of this genus.

Matthew (1915b, p. 319) has placed *Hyopsodus lemoinianus* Cope in synonomy with *H. mentalis*, but it should be noted that the dimensions for *H. lemoinianus* are at about the upper limit of the range, and that the type of this species may have come from the older Gray Bull beds. The species of *Hyopsodus* as currently recognized may not be satisfactorily arranged; there is, however, abundant material representing this genus from various Eocene horizons, and this should lend itself rather well to mathematical analysis.

HYOPSODUS BROWNI Loomis

Four specimens of *Hyopsodus* in the American Museum, collected by Granger and Miller in 1906 from the Knight beds near Knight station in southwestern Wyoming, do not appear to be conspecific with any of the *Hyopsodus* material from the Big Piney–La Barge region. Two of these, A.M. Nos. 12838 and 12839, are lower jaws very close to material in the American Museum from the Lysite beds identified as *Hyopsodus browni.* A third lower jaw, No. 12837, has badly worn teeth which are somewhat smaller but may come within the range of *H. browni.* The fourth, a maxilla with P^3 to M^3, inclusive, is also somewhat smaller, corresponding to A.M. No. 12837. The teeth in the maxilla, however, are larger than any in *Hyopsodus* of the La Barge fauna, although an approach is made in one specimen, U.S.N.M. No. 19657, from southeast of Big Piney. Matthew regarded *Hyopsodus browni* Loomis as a subspecies of *H. powellianus,* between the latter and *H. mentalis* in size. He recorded (1915b, p. 322) it as abundant in the Wind River Lysite, rare in the Big Horn Lysite, and doubtful in the Lost Cabin. This form would appear to be rather indicative of a Lysite age for the Knight beds on Bear Creek.

PHENACODONTIDAE

PHENACODUS PRIMAEVUS Cope

The type specimen of this species was found by Cope in the type Knight on Bear River but it appears not to be represented in upper Knight beds of the upper Green River basin. There is, however, a lower jaw portion in the National Museum collections which Dr. D. H. Dunkle obtained in 1950 from lowest exposed Wasatchian beds, just beneath variegated beds, in S½ sec. 11, T. 21 N., R. 117 W., about 3 miles east of Fossil in Lincoln County, Wyo. The specimen includes P_4 and M_1, and compares favorably with *Phenacodus primaevus.*

MENISCOTHERIIDAE

MENISCOTHERIUM ROBUSTUM Thorpe

Plates 7, 8

Beyond doubt the most striking materials recovered from the upper Knight deposits are the well-preserved skulls, jaws, and partial skeletons of the peculiar condylarth *Meniscotherium.* Remains representing *Meniscotherium* are nowhere so abundantly found, outside of the locality of their original discovery in the lower Eocene of New Mexico.

Following Cope's discovery of a maxilla, to which he gave the name *Meniscotherium chamense* (1874, p. 8), David Baldwin obtained considerable material for Marsh and later for Cope from the New Mexican or San Jose beds. The collection obtained for Cope was the basis for an additional species, *Meniscotherium terraerubrae* Cope (1881b, pp. 493-495), founded on a distinctly larger individual than *M. chamense,* but since there seemed to be no clear separation of these two, Granger (1915, p. 359) regarded *M. terraerubrae* as no more than a subspecies of *M. chamense.* Cope's (1882b, p. 470) species, *Meniscotherium tapiacitis,* based on very much smaller material in the Baldwin collection than either of the above, Granger regarded as valid. Subsequent to Cope's work on these, Marsh (1892, pp. 445-449) named *Hyracops socialis* on material in Marsh's Baldwin collection, but a review of this species by both Granger and Thorpe (1934, pp. 406-409) has resulted in its being placed in synonomy with *Meniscotherium chamense terraerubrae.* A very considerable amount of material representing *Meniscotherium* has subsequently been obtained from the San Jose by Simpson and a thorough understanding of these forms is anticipated.

Outside of New Mexico, materials from the Lost Cabin beds were referred by Granger in 1915 to typical *M. chamense* and a form recognized from Clark Fork Paleocene was described as *Meniscotherium(?) priscum* (1915, p. 360). Then in 1934 Thorpe described a skull and jaw in the Marsh collection from 2 miles west of Aspen, Wyo., which was collected by William Cleburne in 1875. To this he gave the name *Meniscotherium robustum.* An examination of Veatch's (1907, pl. 3) geologic map, showing the position of Aspen as it was originally located on the old route of the Union Pacific, shows *M. robustum* type to have come from Knight beds to the east of the general southward extension of the West Oyster Ridge structure and in the Green River basin of Eocene deposition.

Material of *Meniscotherium* in the upper Knight beds of the upper part of the Green River basin are equaled in abundance only by specimens of *Lambdotherium.* Some 93 specimens, including eight skulls, many jaws and maxillae, and various associated skeletal portions in this collection appear to represent a single species which cannot be distinguished from the type of *Meniscotherium robustum.* In addition to the type, and the Smithsonian collections from the vicinity of Big Piney and La Barge, an *M. robustum* skull was found also by R. W. Brown in a relatively thin zone of Knight beds exposed on Little Bitter Creek between Rock Springs and Green River, Wyo. A detailed description of the skull and other portions of the skeleton of this Knight species will be omitted in deference to studies of related forms in the San Jose fauna currently under way by Simpson.

MENISCOTHERIUM, cf. CHAMENSE Cope

A surprising and rather significant discovery with respect to the occurrence of *Meniscotherium* is that the material obtained from the New Fork tongue represents a distinct species from the typical upper Knight, *M. robustum.* Three individuals from separate localities along Alkali Creek in Sublette County are all immature, but can be readily compared with material of equivalent maturity belonging to the upper Knight *M. robustum.* The New Fork specimens are seen to represent a species distinctly smaller than *M. robustum.* The permanent anterior upper molars preserved in two of the specimens are closely comparable in size, and apparently cannot be distinguished otherwise from these teeth in the type of *Meniscotherium chamense* from the San Jose lower Eocene beds of New Mexico.

PANTODONTA

CORYPHODONTIDAE

CORYPHODON, cf. RADIANS (Cope)

Plate 9

Fragmentary remains of *Coryphodon* are not among the more common materials encountered during a search of upper Knight beds in the vicinity of La Barge or Big Piney. Isolated teeth or tooth portions representing some 13 individuals were preserved, although, to my recollection, probably a much greater amount of very poorly preserved or scarcely identifiable material was discarded or not collected. However, a complete skull, U.S.N.M. No. 16701, in a rather poor state of preservation, was found in SW¼ sec. 24, T. 28 N., R. 114 W., on a branch of Dry Piney Creek in Sublette County, Wyo. Attention was called to the occurrence of this specimen in the Knight lower Eocene in a short paper concerned primarily with the first collections obtained from the Almy Paleocene (Gazin, 1942, p. 217). The skull was discovered in beds separated by faulting, as mapped by A. R. Schultz (1914, pl. 1), from the general area of upper Knight in the Green River basin. The locality was early regarded as possibly somewhat older, and the preservation of the specimen together with the lithology appeared nontypical; nevertheless, a jaw of *Hyracotherium,* cf. *vasacciense* was discovered on the same outcrop, supporting a lower Eocene age.

No less than 24 specific names and six generic names have been applied to American *Coryphodon,* and revisions by Earle (1892), Osborn (1898, pp. 188-218), and Matthew (1899, pp. 33, 36), while differing in detail, have reduced the genera finally to one, and cut the number of species almost in half. Four of the specific names proposed, *Coryphodon radians, Coryphodon semicinctus, Coryphodon latipes,* and *Coryphodon hamatus,* were based on materials from the type Knight exposures, the oldest of which is *Coryphodon radians* Cope (1872a), and which, incidentally, has priority over all others in the North American Eocene.

M^3 in U.S.N.M. No. 16701 is slightly smaller than in the type of *Coryphodon radians,* as reported by Osborn (1898, p. 198), measuring about 31 by 40 mm. instead of 32 by 43 mm. It differs in form from the type in the absence of a posterior spur from the metacone, the presence of which was believed to distinguish *C. radians.* The length of the premolar-molar series, about 160 mm., is intermediate between that of *Coryphodon hamatus* and *Coryphodon elephantopus.* It differs most noticeably from *C. hamatus* Marsh (1884, p. 52, fig. 55) in the absence of the distinctive hypocone development seen in the upper molars of Marsh's type. *C. elephantopus,* as represented by U.S.N.M. No. 111, cited by Osborn as a cotype, has transversely narrower upper premolars than the Dry Piney Creek specimen. Without attempting to revise or determine synonymy of *Coryphodon* species, a task of major proportions, the specimen is referred tentatively to *C. radians.* Some separate teeth of another individual, found in Fogarty Draw, near the Green River, NW¼ sec. 20, T. 28 N., R. 111 W., include a second upper molar which measures about 37 by 43 mm. and may represent a larger species, but this is not certain.

DINOCERATA

UINTATHERIIDAE

Cf. BATHYOPSIS FISSIDENS Cope

A pair of lower jaws, U.S.N.M. No. 19990, including the greater part of the left ramus with P_3 to M_3 and a smaller part of the right ramus with portions of P_2 to M_3, of a uintathere was found in the New Fork tongue of Knight on Alkali Creek about 10 miles above its junction with the Green River. The jaws are rather poorly preserved and the teeth, particularly in the right ramus, are noticeably checked.

Details of the teeth correspond very well to those of the type of *Bathyopsis fissidens* Cope (1881a, p. 194) although those in the New Fork specimen are better worn. The posterior crest of the talonid of the molars is truly a crest and not cuspate as in *Probathyopsis.* The teeth are close to the same size, but slightly larger than in *Bathyopsis* *fissidens.* However, from the measurements given by Cope it would appear that P_4 in the type is much smaller than in the New Fork specimen. The length given is appreciably less than the width, a condition not verified in the figures. The relative size of P_4 corresponds more nearly to the illustration. It seems likely that Cope's dimension is in error and that the length of P_4 is 0.0150 M instead of 0.0105 M.

In spite of the similarity of the teeth, marked divergence is noted in the form of the lower jaw. Preservation of the bone is very poor but there is no doubt that the New Fork specimen lacked the massive inferior flange characterizing the type. Wear of the teeth is evidence of greater maturity than the type, and there is some evidence that the diastema back of the canine was longer; nevertheless, the inferior margin of the jaw would appear to be somewhat like that of the smaller and more primitive *Probathyopsis praecursor* Simpson (1929, p. 2). This striking difference of form would suggest generic, or at least specific, difference; however, a dimorphic condition has been postulated by J. A. Dorr (1952, p. 89) with respect to *Probathyopsis* materials from Hoback Canyon, so that the possibility of such a situation in the upper Wasatchian materials should not be ignored. Pending possible future discoveries clarifying the relationships, the New Fork specimen is tentatively referred to *Bathyopsis fissidens* and regarded as possibly female.

PERISSODACTYLA

EQUIDAE

HYRACOTHERIUM INDEX (Cope)

The specimens of *Hyracotherium* in the La Barge fauna readily fall into three fairly well-defined groups, those of the smallest species belong almost certainly to *Hyracotherium index.* Approximately 35 specimens are in this group including jaws and maxillae which give a good representation of the cheek-tooth series.

Measurements of M_2 in seven lower jaws having this tooth show a range of 6.3 to 6.8 mm. in length and 4.5 to 4.8 mm. in width with an average of 6.6 and 4.6 mm., respectively. M_2 in the type of *Hyracotherium index* measures 6.7 and 4.7 mm.; a close correspondence. The probability of identity would appear to be increased by the fact that the type of *H. index* is also from the Knight formation, but at its type locality on Bear Creek and hence evidently somewhat older. Moreover, it is interesting to note that *H. index* is the second species of *Hyracotherium* to have been described from North America, the first being *Hyracotherium vasacciense* and from the same beds.

Two upper teeth representing *Hyracotherium index* are also included in the Princeton University collection, No. 16172, from Knight beds about 100 feet below Green River strata, 3 miles northwest of Fossil, Wyo. These compare very favorably with *H. index* material from the vicinity of Big Piney and La Barge.

HYRACOTHERIUM VASACCIENSE (Cope)

A much larger number of specimens, approximately 67, from the upper Knight are in a size group clearly distinct from that of *H. index*. The range in size of M_2 in 14 jaws, in which this tooth is present and certainly determined, is 7.4 to 8.4 mm. in length and 5.5 to 6.5 mm. in width, with an average of 7.8 and 5.9 mm., respectively. The type of *Hyracotherium vasacciense* consists of a jaw portion with only M_2 preserved. This tooth measures 8.2 mm. in length and 6.0 mm. in width across both trigonid and talonid, a striking correspondence and well within the range. Granger (1908, p. 222) was inclined to suppress this name but I find it advisable to revive it as the most logical and applicable designation for the rather large series of specimens from these beds. Suppression of this name was awkward inasmuch as there is no question of its representing *Hyracotherium* and it is the oldest for North American species. So far as being indeterminate, the Knight collections under consideration would appear to give it definition and practical significance.

In addition to the above collection from upper Knight beds of the upper Green River basin, there are three right upper molars (A.M. No. 12841) of one individual from the Knight on Bear River near Knight station in the American Museum collection which are about the right size and surely represent *Hyracotherium vasacciense*.

HYRACOTHERIUM, cf. VENTICOLUM Cope

Four specimens in the upper Knight collection appear rather large to be included in the group identified as *Hyracotherium vasacciense*. They do not include M_2, but other teeth are found to be 10 to 20 percent larger on various selected measurements than some of the large individuals of *H. vasacciense*. These unusually large specimens are tentatively referred to the Lost Cabin species, *Hyracotherium venticolum* Cope (1881a, pp. 198-199).

A left maxilla with P_2, P_4, and M_1 in the Princeton collection, No. 16173, from near Fossil, Wyo., first thought to be tapiroid, is probably also to be referred to *Hyracotherium venticolum*. The P_4 shows a prominent anterolingual crest, but with little evidence of accessory cuspules. It resembles P^3 in *Homogalax,* but can be matched in fourth premolar material in the upper Knight collection from the Green River basin referred to *Hyracotherium.* The first molar is more equine than tapiroid and is certainly not *Heptodon.*

Isolated upper and lower teeth in the New Fork collection compare favorably with *Hyracotherium venticolum.* Various measurements of these teeth are very close to those in the type of this Lost Cabin species.

HYRACOTHERIUM, possibly H. CRISTATUM Wortman

Some lower teeth (A.M. No. 12842) among the materials collected by Granger from the type Knight appear too large to be included in *H. vasacciense* or *H. venticolum* and may represent one of the larger species such as *H. cristatum.* They are too narrow to belong to the Wind River *H. craspedotum.*

BRONTOTHERIIDAE

LAMBDOTHERIUM POPOAGICUM Cope

Plate 10

As many specimens of this earliest known titanothere were found in the upper Knight beds as of *Meniscotherium,* and several were obtained from the New Fork; however, the material for the most part was more fragmentary than that of *Meniscotherium.* Nevertheless, one of those rarities in collections of *Lambdotherium,* an almost complete skull, is included.

There is surprisingly little published information on the skull of *Lambdotherium.* The reconstruction in Osborn's (1929, fig. 233) monograph on the titanotheres is based on a maxilla and jugal, a portion of the top of the cranium, the zygomatic process of the squamosal, and a condyle. U.S.N.M. No. 19761, from a locality 12 miles north of Big Piney, Wyo., though somewhat crushed and distorted, in essential details lacks only the basicranium. The rostrum of this skull is broad and the nasals strong and protruding. As noted in *Eotitanops borealis* (Cope) (see Osborn, 1929, fig. 251) the skull is very broad between the orbits, and the postorbital processes are prominent and partially enclose the orbit posteriorly. The most notable difference from *Eotitanops borealis,* in dorsal aspect, is that the sagittal crest extends much farther forward, and the anterior margins of the temporal fossae curve more forward as well as inward from the postorbital processes to meet in the sagittal crest. In *Eotitanops* and later genera the anterior portions of the temporal fossae are widely separated and are divided by a sagittal crest only in their posterior parts. By virtue of this difference the postorbital processes of the frontals are directed backward in *Lambdotherium* instead of forward as in *Eotitanops* and others.

The equine occiput in posterior view is high, narrow, and somewhat rectangular above the mastoid portion, and is directed backward rather than being erect as in Osborn's figure of Gregory's restoration. Two rather prominent vascular foramina are noted in the anteroventral portion of the occiput; apparently the forward of these is between the periotic and squamosal and the posterior and larger between the periotic and exoccipital, somewhat as in horses.

In the absence of the basicranial portion, little of importance, other than the dentition, is observed in the ventral view of the skull. It is noted, however, that the posterior narial opening extends forward between the tooth rows to a point about even with the posterior margin of M^2. Also, the postglenoid process of the squamosal is not nearly so prominent and the circular canal for the audital tube is not so nearly enclosed below by the squamosal from behind.

A study of the dentition together with a revision of the known species of *Lambdotherium* was made by Bonillas (1936) on the basis of materials in the California Institute of Technology from Knight beds between La Barge and Big Piney. Little need be added to his description of the permanent teeth, except perhaps to comment on the character of the so-called mesostyle and other details of P^3 and P^4. The nearly median external style is not in the true position of a mesostyle but appears to be a continuation onto the cingulum of the external rib of the metacone, posterior to the position of the mesostyle between the paracone and metacone seen in the molars. It is weak or absent on these teeth. Also the transverse lophs of P^3 are variable and may or may not exhibit intermediate cuspules. Moreover, Bonillas noted a strong internal cingulum on P^4, but this is variable, as in the molars, and may be discontinuous.

Several milk dentitions are included in the Knight collection which call for some comment. Dp^1 appears to be identical to this tooth in the permanent series and may indeed be the same, although it is in a position immediately anterior to Dp^2 without the diastema of the permanent series. Dp^2 to Dp^4 are, of course, decidedly more progressive than their counterparts in the replacing series. Dp^2 is very much like P^2 except for sharper, better-developed cusps. Dp^3 and particularly Dp^4 are molariform. In Dp^3 the cusp having the position of a protocone, as in other perissodactyles of the Eocene, is not so lingual in position as the hypocone, and the transverse lophs with their accessory cuspules, are not developed. However, the crown of Dp^4 appears to be identical in every respect, except smaller size, to M^1. Both of the posterior upper milk teeth have fully developed mesostyles.

In the lower series Dp_2 is an elongate tooth with a distinct paraconid and metaconid, but scarcely more than a prominent cingulum and a buttresslike rugosity posteroexternal to the metaconid, representing the talonid. The trigonid of Dp_3 is also elongate and the three cusps are almost equally developed; however, no metastylid was noted. The talonid of this tooth is molariform; broad and basined with a well-developed hypoconid and entoconid. Dp_4 is smaller than M_1, but apparently molariform in all respects.

HELALETIDAE

HEPTODON, cf. VENTORUM (Cope)

Remains of *Heptodon* from the upper Knight in the Big Piney–La Barge area are next in abundance to those of horses; however, among the 30-odd specimens none are outstanding or particularly comment-worthy. They consist for the most part of jaw fragments with one to three teeth preserved. One jaw (U.S.N.M. No. 19784), however, is almost entire and although only P_2 and P_3 are preserved the alveolar or root portions of all the remaining teeth from the incisors to M_3 can be seen and over-all proportions determined.

No. 19784 shows a single small alveolus for P_1 immediately anterior to P_2. The presence or absence of P_1 is probably not significant although Seton (1931, p. 47) noted its presence in *Heptodon brownorum* in comparison with other species. The diastema between the canine alveolus and that for P_1 is about 22 mm. The length of P_2 to P_4, inclusive, is about 22.5 mm. and for M_1 to M_3 about 38.5 mm. These proportions are distinctly less than in *Heptodon posticus* or *Heptodon brownorum* and somewhat greater than in *Heptodon calciculus*. The correspondence is closest to *Heptodon ventorum* although measurements of teeth in the type are greater than in most of the Knight specimens. There is some variation in size of teeth between specimens in the collection, but I am inclined to regard them as representing a single species which may well be *H. ventorum*.

Among the specimens collected by Granger and Miller from beds in the vicinity of the type locality of the Knight formation is a fragment of a tapiroid lower jaw (A.M. No. 12840) with P_3, P_4, and the anterior portion of M_1. Like the upper Knight materials from the vicinity of Big Piney and La Barge, the teeth are a little smaller than in the type of *Heptodon ventorum* but apparently not closer to *H. calciculus.* The better development of the entoconid on P_4, moreover, suggests *H. ventorum* rather than *H. calciculus* as represented by their types.

A single lower tooth in the Princeton material, No. 16174, from near Fossil, Wyo., can be almost exactly duplicated by Dp_4 in *Heptodon* material from the upper Green River basin and in American Museum *Heptodon* material from the Wind River basin.

HEPTODON, species

In the New Fork collections are various isolated teeth and tooth portions, including an M_3 which is a little larger than in the upper Knight material referred to *Heptodon ventorum.* The M_3 has about the length and width of this tooth in the type of *Heptodon posticus;* however, on this basis it cannot be clearly distinguished from *H. brownorum.*

HYRACHYIDAE

HYRACHYUS, species

A complete last upper molar and fragments of other teeth represent a species of *Hyrachyus* in the New Fork fauna not far in size from *Hyrachyus agrestis,* or *H. modestus* as revised by Wood, from the Bridger middle Eocene. McGrew (*in* Donovan, 1950, p. 64) recognized the presence of *Hyrachyus* in the New Fork on the basis of tooth fragments collected by J. H. Donovan, a student at the University of Utah, however, in the absence of other, more critical evidence, regarded the beds as of Bridger age. *Hyrachyus* has been found, though rarely, in Lost Cabin beds. The New Fork M^3 measures 20.3 mm. anteroposteriorly by 22.9 mm. in its greatest transverse diameter.

ARTIODACTYLA

DICHOBUNIDAE

DIACODEXIS, near D. SECANS (Cope)

A single specimen, U.S.N.M. No. 19218, from north of Big Piney, consisting of lower jaw portions and including M_1 from both right and left sides, and left M_3, is regarded as belonging to a species of *Diacodexis* close in size to *Diacodexis olseni* Sinclair (1914, pp. 292-293) or *Diacodexis secans* (Cope) (1881a, pp. 187-188). M_1 is the same length as the tooth in *D. secans* or *D. olseni* but is appreciably narrower than in the latter. M_3 in Sinclair's type is not complete so that the length cannot be determined, but its width is also much greater than that in No. 19218. M_3 in *D. secans* is only a little wider and longer. The length and greatest width of M_1 in the Knight specimen are 4.6 and 3.4 mm., respectively. The dimensions for M_3 are 5.5 and 3.7 mm. There is a likelihood that the Knight specimen represents *Diacodexis secans* although it is noted that the apices of the cusps in the type are noticeably closer together transversely, and the entoconid of M_3 is much weaker. Moreover, in the absence of P_4, which is surely distinctive of *D. secans,* no certain assignment can be made.

Sinclair's revision of *Diacodexis* brought some order out of chaos, but left something to be desired in omitting consideration of *Diacodexis nuptus* and *Diacodexis secans.* Also, from a consideration of the measurements of the type of *Diacodexis chacensis* and other material from the San Jose beds, together with a large suite of specimens from the Gray Bull, I am inclined to regard the Gray Bull species as specifically distinct from *Diacodexis chacensis.* The specimen that Sinclair referred to as a paratype of *D. chacensis* did not come from the San Jose and is appreciably smaller than the type, as measured by Cope (1875, p. 15). The position of the type specimen of *D. chacensis* at the upper limits, or distinctly beyond the upper limits of Gray Bull materials, in various measurements, coupled with geographic and horizon differences, would lead one to regard the species as distinct. For this reason I would prefer to revive the oldest Gray Bull name, *Diacodexis metsiacus* (Cope) for these specimens. *Diacodexis brachytomus* (Cope) and *Diacodexis laticuneus* (Cope) are probable synonyms. *Diacodexis robustus* Sinclair from the Gray Bull is apparently valid. *Diacodexis nuptus* (Cope) and *Diacodexis secans* (Cope) are described from the Wind River beds, hence, according to Simpson (1933, pp. 115-116), are from the Lost Cabin horizon. *D. nuptus* is exceedingly small in comparison with Gray Bull materials, and the paraconid in the preserved lower molar is rather well forward in position and slightly less lingual than observed in the Gray Bull species. *D. secans,* on the other hand, has large teeth, and is particularly characterized by the relatively large size of P_4. It is further observed that the molars in *D. secans* have the apices of their cusps relatively closer together transversely than in any other *Diacodexis* material observed. *Diacodexis olseni,* as noted above, is characterized by the relatively greater width of the molars. No data exist on the variation in this respect, nor in the characters of *D. secans*. It is noted that the difference in length of P_4 between *D. secans* and *D. olseni* is a little greater than Sinclair has shown as the variation of the length of this tooth in Gray Bull materials.

DIACODEXIS?, species

Van Houten (1945, p. 458) noted the presence of *Diacodexis* material from the Knight formation in the collections of the American Museum. Two lower jaws are so recorded in their catalog but these could not be found. They were collected by Granger and Miller from vicinity of the type Knight section on Bear Creek, near Knight station. There is no evidence as to the species represented.

BUNOPHORUS, cf. MACROPTERNUS (Cope)

Difficulty was early encountered in attempting to identify, as representing *Bunophorus* or *Wasatchia,* certain materials in the upper Knight or La Barge collection. Review of the dental characters, outlined by Sinclair (1914, pp. 268-276) as distinguishing these two genera, would appear to be resolved into inflation of the lower premolars, the extent to which the paraconid is developed on lower molars, and the form of M_3. The premolar difference is largely one of degree, the presence or absence of a weak or vestigial paraconid is not always significant in other groups, and the form of M_3 is likely variable as in *Diacodexis.* However, the combination of the characters outlined by Sinclair, together with the development of the hypoconulid, which was noted to be more distinctive in those specimens exhibiting a more distinctive paraconid, might justify retention of both genera.

The upper Knight collections include five lower-jaw portions very close to one another in size and form of teeth, and surely represent a single species. The best of these is a right mandibular ramus, U.S.N.M. No. 19210, with P_4 to M_3, inclusive. The teeth in this are moderately worn so that the presence or absence of a paraconid cannot be determined; however, P_4 would appear to be somewhat more inflated than in figures of *Wasatchia.* M_2 and M_3 in No. 19208 are slightly worn and do not appear to have had a paraconid, and M_3 conforms to the description of *Bunophorus* except that the talonid is nearly as wide as trigonid. In No. 19209 P_4 is a little larger and more inflated than in No. 19210, and M_1 shows a very small enamel lake representing the paraconid. M_1 in No. 19207 also shows definite evidence of a paraconid, whereas M_2 does not. However, M_2 in No. 19213 shows a small paraconid but is otherwise not distinctive. Sinclair observed the presence of a small paraconid on M_1 of *Bunophorus macropternus* and a vestige on M_3 but not on M_2. The upper Knight material, though limited, lacks a vestige of this cusp on M_3, but in one instance includes it on M_2. The correspondence of the upper Knight form would appear to be closer to *Bunophorus* than to *Wasatchia* and in size is very near *Bunophorus macropternus.*

In addition to the lower jaws there are two specimens showing upper teeth, believed to be of the same species. One of these, U.S. N.M. No. 19212, includes M^1 and M^2 and the other is an isolated molar, probably M^2. Upper teeth of *Bunophorus* have not previously been described, and as may be anticipated, their resemblance is very close to those figured of *Wasatchia.* The upper Knight superior teeth are relatively little worn and the most striking feature is their extremely bunodont appearance. The cusps are all blunt, nearly circular cones, with but slight buttresses on the anterior and posterior slopes of paracone and metacone, and between the protocone and the two accessory cusps, the protoconule and metaconule. There is no great disparity in size of cusps, although the protocone is slightly larger than the about-equal paracone and metacone. Slightly smaller than the latter two are the approximately equivalent protoconule, metaconule, and hypocone. The hypocone is at the posterolingual extremity of the cingulum, which surrounds all but the lingual surface of the tooth.

HEXACODUS,[21] new genus

Generic characters.—Tooth structure much as in *Sarcolemur* Cope, but P_4 appears more inflated medially with metaconid incipient or weak. Trigonid of lower molars with inner pair of cusps higher than protoconid and anteroposteriorly compressed, but less so than in *Sarcolemur.* Paraconid and metaconid less closely appressed than *Sarcolemur,* and metaconid rather than paraconid the larger and higher. Cross crests of trigonid weak and oblique crest from hypoconid less distinctly developed on posteroexternal slope of metaconid. Hypoconid crescentic and entoconid conical with hypoconulid on posterior cingular shelf, distinct and decidedly posterior to hypoconid and entoconid, as in *Sarcolemur.*

Type species.—Hexacodus pelodes, new species.

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[21] From Greek ἕξ, six; ἀκή, point; ὀδούς, tooth—with reference to the six cusps, including the hypoconulid, of the lower molars.

HEXACODUS PELODES,[22] new species

Plate 11, figures 1-3

Type.—Left ramus of mandible with P_4 to M_2, inclusive, U.S.N.M. No. 19215.

Horizon and locality.—Upper Knight beds, La Barge fauna, SW¼ sec. 33, T. 32 N., R. 111 W., 12 miles north of Big Piney, Sublette County, Wyo.

Specific characters.—Teeth slightly smaller and relatively a little narrower than in *Sarcolemur pygmaeus.* Other characters not distinguished from those of genus.

Description.—Eleven specimens, all lower-jaw portions or lower teeth, belong to *Hexacodus pelodes.* The material was first thought to represent *Diacodexis,* but upon more critical examination it was found that only one specimen in the upper Knight collections of the upper Green River basin represents *Diacodexis.* The remainder of these smaller dichobunids are recognized to be of a form more closely related to Bridger *Sarcolemur.*

The fourth lower premolar in the type of *H. pelodes* is perhaps a little more rounded or inflated externally than in *S. pygmaeus* but the metaconid, well developed in the latter, is incipient or scarcely more than a flexure or swelling on the lingual side of this tooth in the earlier type. The paraconid as in *Sarcolemur* is prominent and turned sharply inward. On the rather small heel of P_4 in the *H. pelodes* type a distinctly isolated entoconid is observed. Two other specimens of *H. pelodes* exhibit P_4, and in one this tooth is more inflated and the accessory cusps are more obscure. In the other, the tooth is only slightly wider and has the equivalent parastyle, a better-developed metaconid, but apparently no entoconid.

The lower molars of *H. pelodes* are less specialized in the peculiarities of the trigonid noted in *Sarcolemur pygmaeus,* although the talonids are very similar in the two forms. In *S. pygmaeus* it is noted that the arcuate anterior crest of the trigonid may be somewhat higher than the posterior, and the paraconid is set slightly inward and a little higher than metaconid. Both are higher than the protoconid and these differences in height are further emphasized by the manner in which the tooth is worn through occlusion. Moreover, in *Sarcolemur* the metaconid appears to be joined from near its summit to the anterior wing of the crescentic hypoconid. In some third molars the metaconid-

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[22] From Greek πηλώδης, muddy; with reference to Muddy Creek, where the type specimen was found.

hypoconid crest is more conspicuous than that between the metaconid and protoconid. In *H. pelodes* the paraconid and metaconid, though high and close together, are not so closely appressed as in *Sarcolemur* and the metaconid is a little the larger; however, in wear the metacone may be reduced so that the tooth more closely resembles *Sarcolemur.* The crest from the hypoconid rises on the posterointernal slope of the metaconid, but not so high and with less emphasis.

The talonid of the first two molars, as in *Sarcolemur,* exhibits a crescentic, though high-cusped, hypoconid which likewise does not connect directly with the prominent conical entoconid, but sends a weak spur posteriorly from the horn of the crescent to the hypoconulid which is situated on a prominent posterior ledge or cingulum. The structure of this portion of the tooth is entirely unlike that in *Diacodexis.* In M_3 of *H. pelodes* the hypoconulid is an exaggeration of the condition noted in preceding molars, and with this portion of the heel transversely more constricted than in *Diacodexis.* A central crest extends forward from the hypoconulid to the cleft between the hypoconid and entoconid, much as in *Sarcolemur.*

Discussion.—Hexacodus pelodes would appear to be the first authentic record of the *Sarcolemur* or *Antiacodon* type of dichobunid in the lower Eocene, although species from Wasatchian beds have been referred to this group. Erroneously allocated have been *Antiacodon mentalis* and *Antiacodon crassus.* The first of these is now included in *Hyopsodus,* and the second does not represent this group, as may be inferred from Cope's illustration (1877, pl. 45, fig. 15) and as he later recognized (1884, p. 233), although its correct allocation is not known. A third name, *Sarcolemur bicuspis,* was listed without description by Loomis (1907b, p. 357) in a faunal list of materials collected from the lower levels of Tatman Mountain in the Big Horn basin. The name is a nomen nudem and there may be some doubt as to whether the material which he so designated represented this genus. Simpson (1945, p. 143) has listed *Sarcolemur* as lower Eocene and *Antiacodon* as middle Eocene, and although it seems likely that the letter L, there used for lower Eocene, is a typographical error, a shadow of a doubt persists for the following reason: The type of *Sarcolemur* is *S. furcatus,* the type specimen of which was collected by Cope in 1872 "from the bluffs of the Upper Green River" (1873b, p. 608). That year, according to Cope's account (ibid., p. 545), he traveled up the Green River from about 17 miles above the town of Green River, as far as La Barge Creek, so there is the remote possibility that *S. furcatus* came from the upper Knight near

La Barge Creek. However, much of the material similarly labeled in Cope's collection is Bridger in age and none so far as known is Knight; moreover, the type of *S. furcatus* resembles other Bridger materials rather than *Hexacodus pelodes.*

In all probability *Sarcolemur* is a synonym of *Antiacodon.* Cope originally referred his species to Marsh's genus, but later erected *Sarcolemur* because he felt Marsh's description was inadequate (1877, p. 148). *Antiacodon venustus* Marsh (1872, p. 210) has never been figured, nor the type, so far as I know, compared with that of *Sarcolemur furcatus,* so that the equivalence of these two genera remains in doubt. Nevertheless, the pertinent Bridger materials in the National Museum collections, apparently representing but a single species, are cataloged as *Antiacodon pygmaeus.*

MEASUREMENTS OF TYPE LOWER JAW OF
Hexacodus pelodes, NEW SPECIES, U.S.N.M. NO. 19215

	mm.
Length of P_4 to M_2, incl.	12.8
P_4, anteroposterior diameter: transverse diameter	4.5: 2.8
M_1, anteroposterior diameter: greatest transverse diameter	4.2: 3.0
M_2, “ “ “ “ “	4.4: 3.7
Depth of jaw beneath point between M_1 and M_2, lingually	6.7

HEXACODUS UINTENSIS,[23] new species

Plate 11, figure 4

Type.—Left ramus of mandible with M_1 and M_2, Princeton University collection No. 16175.

Horizon and locality.—Knight beds, 100 feet below Green River formation, about 3 miles northwest of Fossil, Uinta County, Wyo.

Description.—Distinctly larger than *Hexacodus pelodes* with trigonid relatively of somewhat greater anteroposterior extent. Paraconid and metaconid more distinctly separated. Talonid much as in *H. pelodes* with hypoconulid on posterior cingulum and distinctly posterior to low divide between hypoconid and entoconid.

Discussion.—This species of *Hexacodus* from the Princeton locality near Fossil is clearly distinct from that of the La Barge fauna, and is somewhat more removed from the middle Eocene *Sarcolemur* in the construction of its lower molars. In this respect it is a trifle more generalized and less removed from the *Diacodexis* type of artiodactyl molar.

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[23] Named for Uinta County, Wyo.

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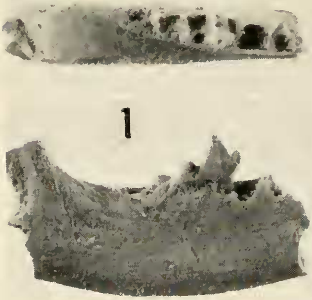
PLATES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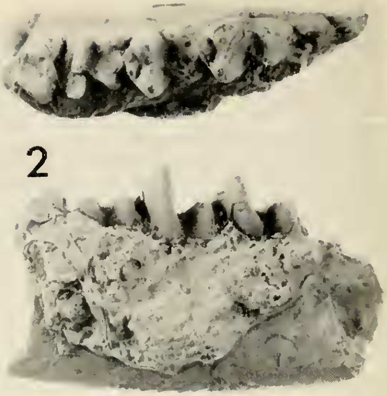
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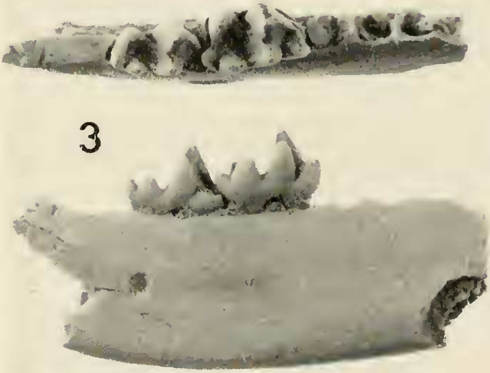
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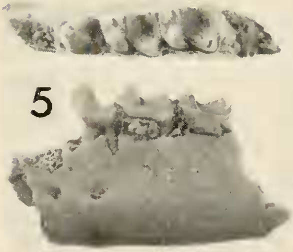
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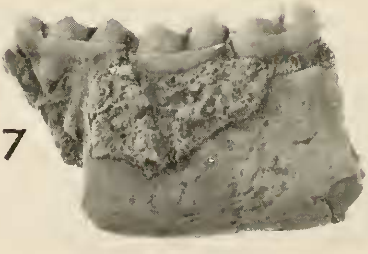
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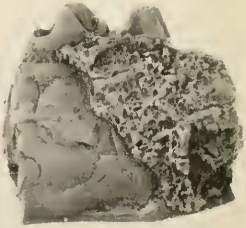

8

MARSUPIALS, INSECTIVORE, AND PRIMATES FROM THE KNIGHT LOWER EOCENE

PLATE 1

FIG. 1. *Peratherium chesteri,* new species: Right ramus of mandible (U.S.N.M. No. 19199), type specimen, occlusal and lateral views. Approximately six times natural size.

FIG. 2. *Diacodon pineyensis,* new species: Left ramus of mandible (U.S.N.M. No. 19204), type specimen, occlusal and lateral views. Approximately four times natural size.

FIGS. 3 and 4. *Peratherium edwardi,* new species: 3, Left ramus of mandible (U.S.N.M. No. 19200), type specimen, occlusal and lingual views; 4, left maxilla (U.S.N.M. No. 19206), occlusal view. Approximately five times natural size.

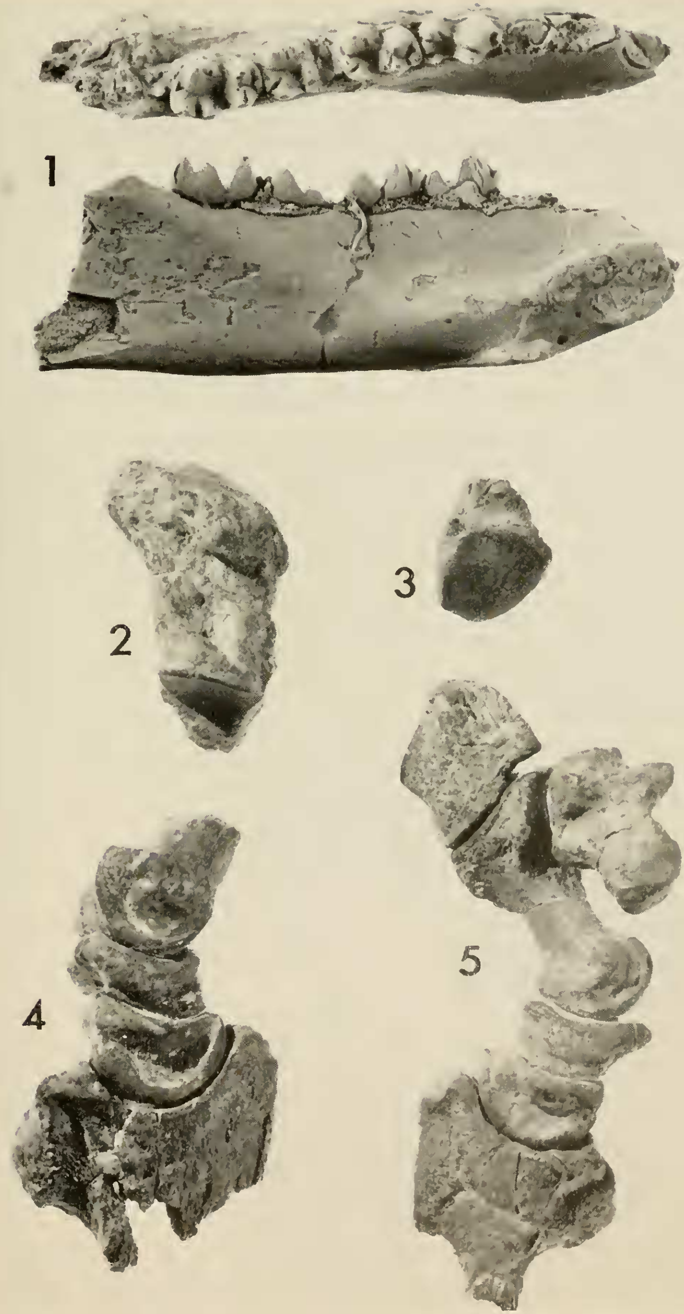
FIG. 5. *Paratetonius? sublettensis,* new species: Left ramus of mandible (U.S.N.M. No. 19205), type specimen, occlusal and lateral views. Approximately five times natural size.

FIGS. 6-8. *Notharctus limosus,* new species: 6, Left maxilla (U.S.N.M. No. 19293), occlusal view; 7, right ramus of mandible (U.S.N.M. No. 19294), type specimen, lateral view; 8, left ramus of mandible (U.S.N.M. No. 19294), type specimen, lingual view. Approximately three times natural size.

PLATE 2

FIG. 1. *Cynodontomys knightensis*, new species: Left ramus of mandible (U.S.N.M. No. 19314), type specimen, occlusal and lingual views. Approximately three times natural size.

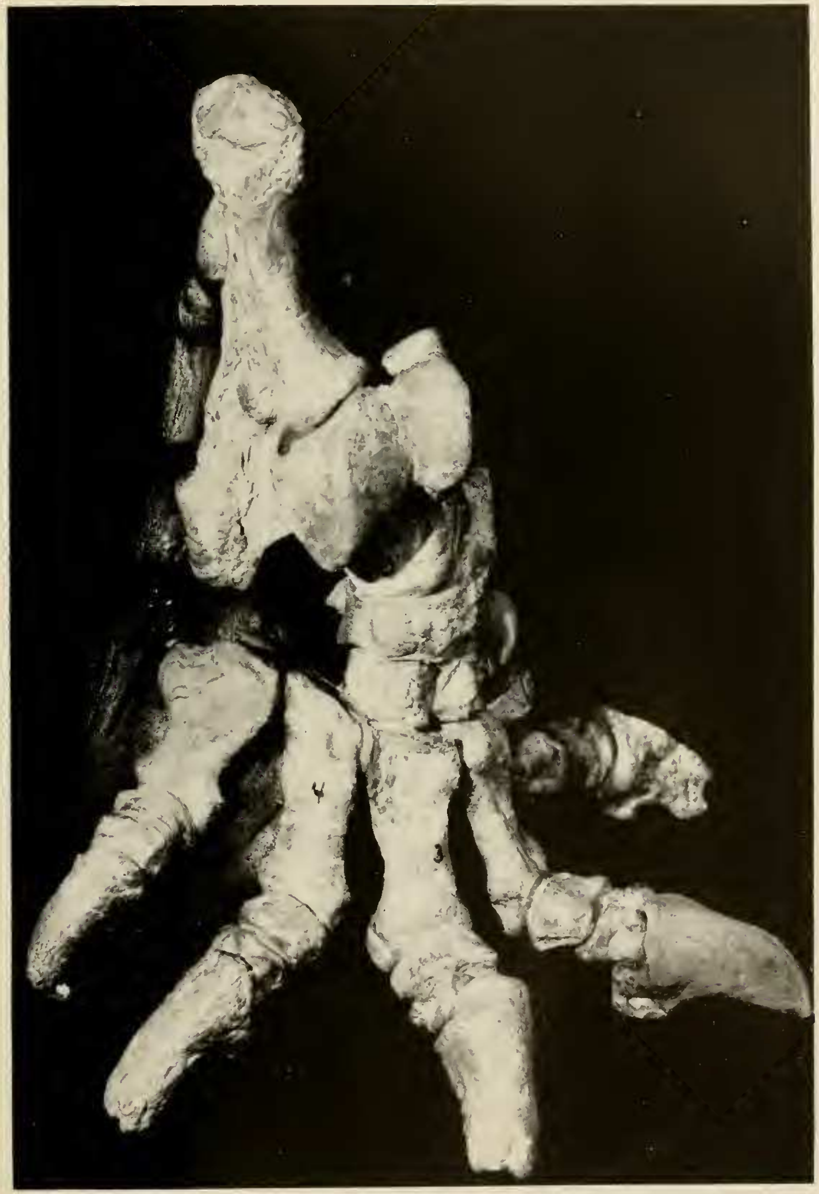
FIGS. 2-5. Undetermined stylinodont: Fore foot (U.S.N.M. No. 18425); 2, pisiform, lateral view; 3, scaphoid, proximal view; 4, 3d(?) digit, inner view; 5, fourth digit with unciform and fifth metacarpal, lateral view. Natural size.



INSECTIVORE AND TAENIONDONT FROM THE KNIGHT LOWER EOCENE

TAENIODONT FOOT FROM THE KNIGHT LOWER EOCENE

Articulated right hind foot of undetermined stylinodont (U.S.N.M. No. 18425), anteromedial view. Internal cuneiform and distal phalanx of 2d digit partially restored from left foot. A portion of the proximal extremity of second metatarsal not represented. Approximately four-fifths natural siz.



TAENIODONT FOOT FROM THE KNIGHT LOWER EOCENE

Articulated right hind foot of undetermined stylinodont (U.S.N.M. No. 18425), anterolateral view. Fifth metatarsal and distal phalanx of second digit partially restored from left foot. Approximately four-fifths natural size.

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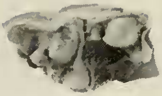

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CREODONTS FROM THE KNIGHT LOWER EOCENE

Figs. 1-3. *Prolimnocyon elisabethae*, new species: 1, Left maxilla (U.S.N.M. No. 19348), occlusal view of M^1 and M^2; 2, right maxilla (U.S.N.M. No. 19348), occlusal view of P^4 and M^1; 3, left ramus mandible (U.S.N.M. No. 19350), type specimen, occlusal and lateral views. Approximately one and one-half natural size.

Fig. 4. *Vulpavus asius*, new species: Left ramus of mandible (U.S.N.M. No. 19337), type specimen, occlusal and lateral views. Approximately one and one-half natural size.

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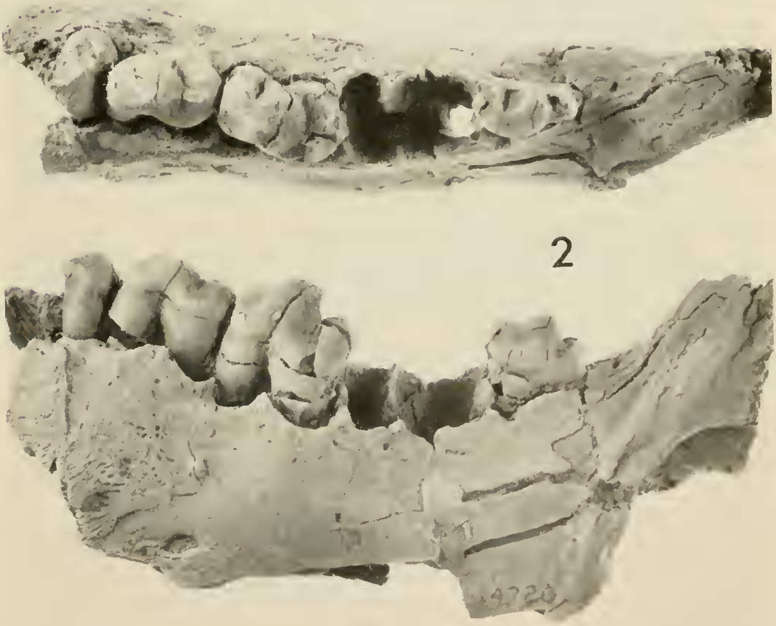

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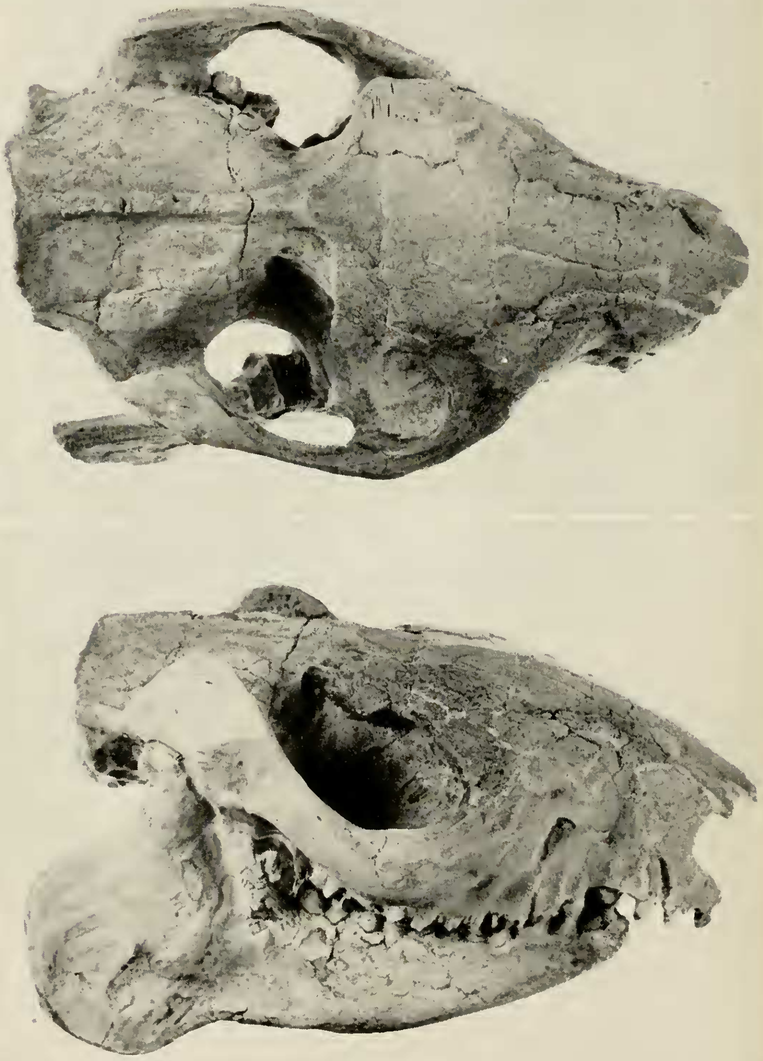
Creodonts from the Knight Lower Eocene

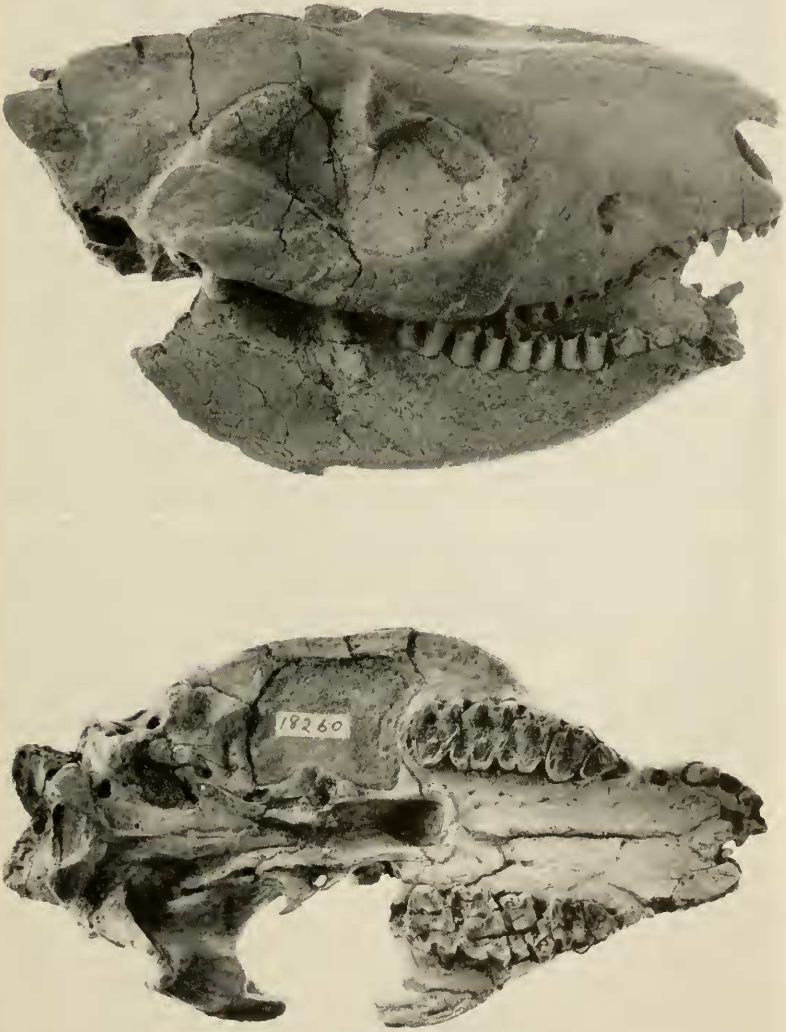
Fig. 1. *Uintacyon asodes*, new species: Left ramus of mandible (U.S.N.M. No. 19351), type specimen, occlusal and lateral views. Approximately one and one-half natural size.

Fig. 2. *Ambloctonus major* Denison: Left ramus of mandible (P. U. No. 14720), occlusal and lateral views. Natural size.



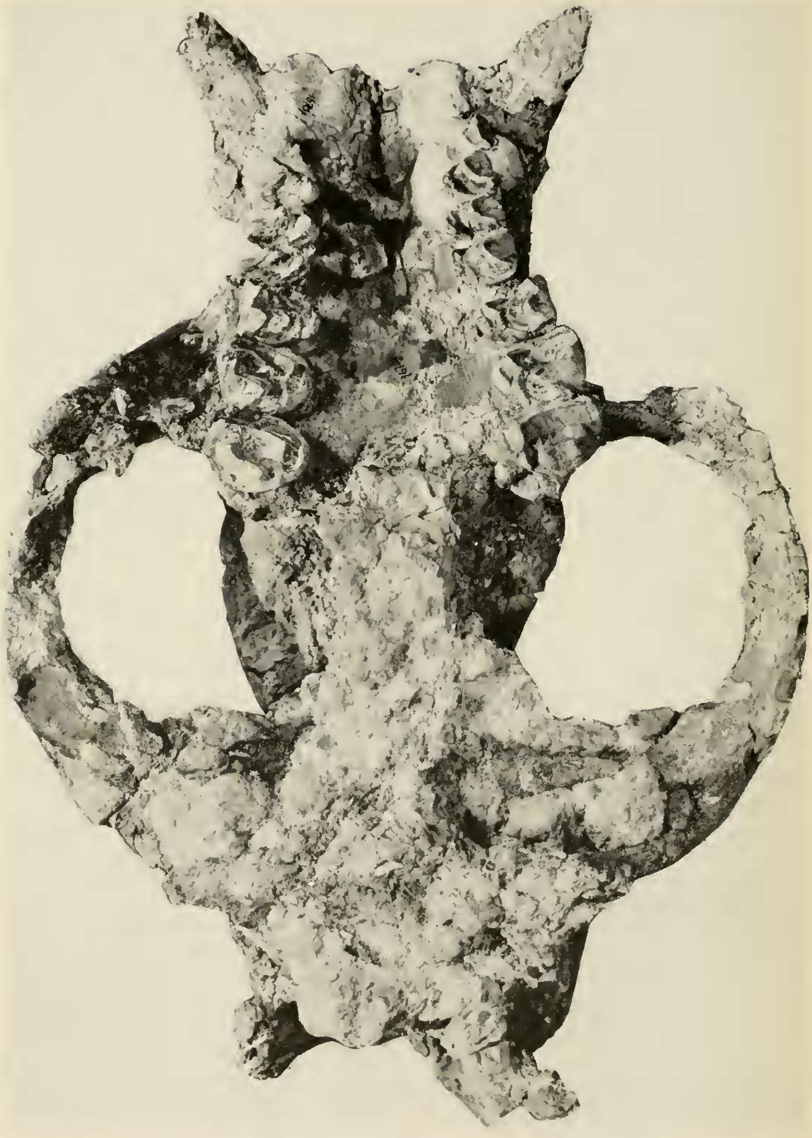
MENISCOTHERIUM FROM THE KNIGHT LOWER EOCENE

Meniscotherium robustum Thorpe: Skull and mandible (U.S.N.M. No. 18283), dorsal and lateral views. Upper, approximately three-fourths natural size; lower, two-thirds.



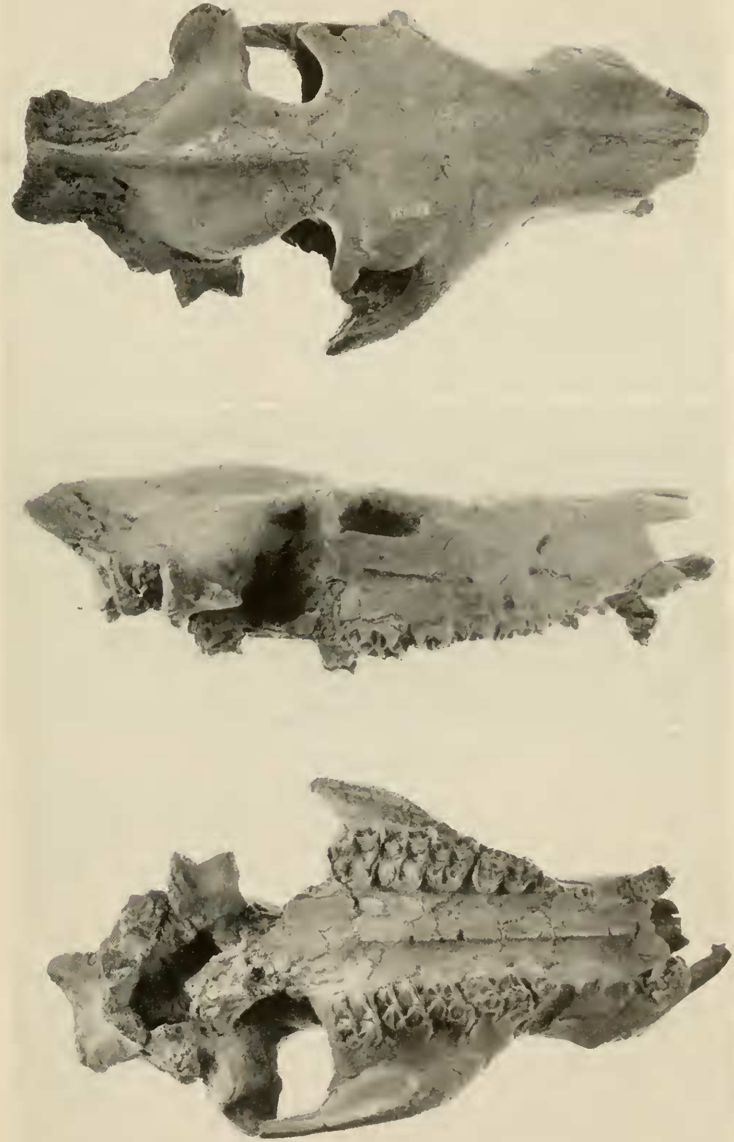
MENISCOTHERIUM FROM THE KNIGHT LOWER EOCENE

Meniscotherium robustum Thorpe: Above, skull and mandible (U.S.N.M. No. 19505), lateral view; below, skull (U.S.N.M. No. 18260), ventral view. Approximately three-fourths natural size.



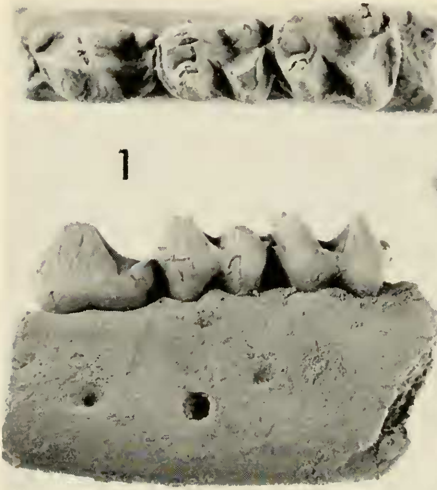
CORYPHODON FROM THE KNIGHT LOWER EOCENE

Coryphodon, cf. *radians* (Cope): Skull (U.S.N.M. No. 16701), ventral view. Approximately one-third natural size.



LAMBDOTHERIUM FROM THE KNIGHT LOWER EOCENE

Lambdotherium popoagicum Cope: Skull (U.S.N.M. No. 19761), dorsal, lateral and ventral views. Approximately one-half natural size.



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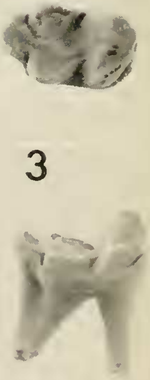

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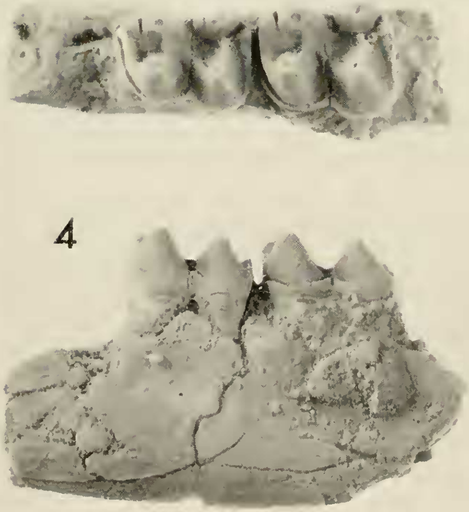

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Artiodactyles from the Knight Lower Eocene

PLATE 11

FIGS. 1-3. *Hexacodus pelodes*, new genus and species: 1, Left ramus of mandible with P_4—M_2 (U.S.N.M. No. 19215), type specimen, occlusal and lateral views; 2, right ramus of mandible with M_3 (U.S.N.M. No. 19217), occlusal and lateral views; 3, right M_3 (U.S.N.M. No. 19219), occlusal and lateral views. Approximately four times natural size.

FIG. 4. *Hexacodus uintensis*, new species: Left ramus of mandible with M_1-M_2 (P.U. No. 16175), type specimen, occlusal and lateral views. Approximately four times natural size.